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## Table of Contents.

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LEADING ARTICLES—	Page.	CURRENT COMMENT—	Page.
Fractures of the Lower End of the Humerus and their Complications, by S. H. SCOUGALL, M.B., Ch.M. . . . .	873	Anorexia Nervosa . . . . .	892
Fractures around the Elbow Joint, by LYLE BUCHANAN, M.B., Ch.M., F.R.C.S., F.R.A.C.S. . . . .	881	Amidopyrin and Blood Cells . . . . .	893
REPORTS OF CASES—		SPECIAL ARTICLE—	
Chronic Intussusception Reduced by Rectal Injection after Four Months, by DOUGLAS ANDERSON . . . . .	889	The Interrelationships of the Sex Hormones . . . . .	894
REVIEWS—		BRITISH MEDICAL ASSOCIATION NEWS—	
Paget's Disease of the Nipple . . . . .	889	Scientific . . . . .	897
Bacteriology for Students and Practitioners . . . . .	889	Nominations and Elections . . . . .	898
A Text-Book of Pathology . . . . .	890	CORRESPONDENCE—	
Emergency Surgery . . . . .	890	Oxyuriasis: A Possible Main Source of Infestation . . . . .	899
A Medical Curiosity . . . . .	890	UNIVERSITY INTELLIGENCE—	
LEADING ARTICLES—		The University of Sydney . . . . .	899
Thoracic Surgery . . . . .	891	BOOKS RECEIVED . . . . .	899
		MEDICAL APPOINTMENTS VACANT, ETC. . . . .	900
		MEDICAL APPOINTMENTS: IMPORTANT NOTICE . . . . .	900
		EDITORIAL NOTICES . . . . .	900

### FRACTURES OF THE LOWER END OF THE HUMERUS AND THEIR COMPLICATIONS.<sup>1</sup>

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PROBABLY no common fracture region is the site of such grave complications as that of the elbow joint, and anxiety in the treatment of these injuries at some time is inevitably our common lot. Limitation of function is often unavoidable; but it is not uncommon to see elbows in a position of deformity not compatible with good function.

Normal and Comparative Anatomy.

It is widely accepted that structure is the register of function, and while an accurate knowledge of

<sup>1</sup>Read at a meeting of the New South Wales Branch of the British Medical Association on October 29, 1936.

existing structure and function is a primary essential, the fascinating field of comparative anatomy gives us perspective. A digression may therefore be permissible.

If in the upright posture we consider stability and mobility in the morphologically comparable joints at the knee and at the elbow, it is seen that stability is of prime importance at the knee and mobility of chief importance at the elbow. With the human knee joint solely capable of complete extension, portion of its stability lies in its passive locking mechanism, which also minimizes expenditure of muscle energy.

In the quadruped stability is of equal importance in the fore and hind limbs; yet in the horse the comparative joints to the elbow and knee (stifle joint) are both incapable of extension beyond 150°, though they support a large body weight. It is interesting to note that the horse not only maintains stability on these flexed limbs, but does so even when sleeping, as he habitually does, in the standing position. Though the lower joints of both

limbs have some degree of passive locking mechanism, the chief factor here is the persistent activity of the spinal reflex arc during sleep, as the spinal cord is of much more importance, relatively to the brain, in lower vertebrates than in man.

It is not entirely clear how the fin of a fish, practically a singly jointed lever, amply sufficient for the movement of a body in a fluid medium, becomes transformed into a many jointed system of levers suitably adapted for progression on land. The primitive animals necessary for study and which would give the clue are apparently lost to science.

From as low down in the evolutionary scale as the Amphibia, however, up to the highest mammals, there is a single ground plan. This is as follows: upper arm (*brachium*), forearm (*antibrachium*), wrist (*carpus*), and hand (*manus*).

The first animals to raise their bodies were the primitive amphibians of the Permian age, the labyrinthodonts, which, however, were mainly crawlers. In the same age arose the mammal-like reptiles (*anomodonts et cetera*), whose bodies were normally off the ground during progression. In our own fauna<sup>(1)</sup> the mode of progression of the platypus is essentially reptilian, while the echidna was one of the earliest forms with bodies raised from the ground, and the frilled lizard of Queensland (*Chlamydosaurus kingii*) is able to run on its hind legs with its tail as a balance, bringing the forelimb off the ground, as is seen in the kangaroo.

The anterior limbs of the body are more subject to variations than the posterior, being adapted for many diverse purposes, as for example: (i) pulling the body along the ground, as in the blue-tongued lizard (Reptilia); (ii) supporting the body as well as propelling it, as in the echidna (Monotremata); (iii) digging and support, as in the wombat (Marsupialia); (iv) prehension only, as in the kangaroo (Marsupialia); (v) prehension and support, as in the koala and opossums. They may be adapted for flight in such mammals as the bat, and may even be modified back to an aquatic limb again, as in the Pinnatipedes, the Cetacea and the Sirenia.

The factors are complex in the determination of the evolutionary changes towards, on the one hand, straight limbs with extending joints, and on the other, the limb in the flexed position with marked limitation of extension. This aspect is dealt with at length by W. K. Gregory<sup>(2)</sup> in discussing the principles of quadrupedal locomotion. Cope had previously observed that in animals which do not leap, that is, animals that run and walk, the proximal segments of the limb are elongated, while in animals which run by leaping, whether on all fours or on the hind limbs only (as the kangaroo), the distal segments of the limb are elongated. Animals which do not leap are always plantigrades and have very short feet but elongated thighs and mostly elongated tibiae. Osborne concluded that the straightening of the limb was an adaptation designed to transmit increasing weight through a vertical shaft, with the shifting of the facets into the direct line of pressure. The term "rectigrade"

was applied to the pose of elephants and similar heavy forms with straight limbs. Gregory discusses the contrast between the limbs and musculature of these graviportal ungulates and the slender, swift-footed or cursorial types.

The primitive ungulates had environmental conditions which set the premium of survival upon improvements in endurance and speed, which were attained on diverse lines of evolution in the elephant and in the antelope. Gregory draws attention in the limbs of quadrupeds to the principles of compound levers, and brings evidence to show that the relative dispositions of the upper, middle and lower segments are adapted to specific loads, muscular power and speed. He maintains that the function of the distal portion (the hand or the foot) has been the dominant factor in the determination of the diverse modifications in the musculature, proportion and angulation of the proximal segments of the limb.

If attention is strictly confined to the component bones of the elbow joint, various changes are noted. In the humerus it is observed that, as well as variations in its form and relative length, and the presence of ridges and elevations for the insertions of muscles, there are some instances of a supracondyloid foramen at the distal end.<sup>(3)</sup> This serves for the passage of the median nerve; an excellent example is afforded by the koala (Marsupialia).

Cases are on record of the occurrence of this foramen in human humeri, and there are many such specimens in the Institute of Anatomy, Canberra, especially in aboriginal bones. Some humeri show spicules of bone at this site and no foramen. These are considered by some anatomists to be evidences of a bony edge, which would have formed the foramen.

The radius and ulna in monotremes and in all mammals in which the radius is fixed in the position of pronation are both connected with the humerus by a hinge joint allowing movement in one plane. It is only in the prehensile mammals that the bones of the forearm, instead of having movement as a whole, articulate with one another. The movements of pronation and supination are at a maximum development in climbing marsupials, such as the koala and opossum.

The ulna is at all times more important in forming the chief connexion with the humerus, while the radius is the main support of the hand. Even in those animals, for example the ungulates, in which the ulna is comparatively greatly reduced in size and more or less fused with the radius, the olecranon process is always distinguishable as the bony prominence for the attachment of the extensor muscles of the forearm. The human elbow joint is so adapted for prehensile movements only that the ulna is the sole bone forming the elbow joint with the humerus; but for adequate functioning of the forearm supination and pronation must be possible. Treatment of injuries to the elbow joint must necessarily include the upper articulation of the radius and ulna.



It is clear from the foregoing that all types in the animal scale above the fishes have an elbow joint, and that any elbow joint must allow flexion and extension. The degree of extension in some is much greater than in others, to meet the varying requirements of the individual animal. New structures are not necessary for this increased power of extension; but modifications of the existing bones and added work for the extending muscles are required. This point is more clearly understood in relation to the lower limb. In all animals the knee is capable of extension; but the amount of work which the quadriceps muscle must do to keep a man upright on one extended leg is considerably more than the amount of work required from the same muscle in the platypus, where the lower limb is not even required to support body weight. This principle of the superimposing of added function on that of an already existing muscle is the basis of muscle reeducation work, and the successful treatment of muscle weakness, whether due to injury or disease, depends on a thorough understanding of this basic principle.

In the Equidae there are some interesting points in this connexion. The wrist of the horse comes to occupy the middle of the length of its foreleg and constitutes what is incorrectly called the "knee". The heel is similarly raised to the middle of the hind leg and is termed the "hock". The forearm is fixed in the prone position, and at the same time the axis of the humerus is inclined obliquely backwards and downwards at right angles with the long axis of the scapula. The long axis of the humerus makes a great angle with that of the forearm. Each forelimb forms a sort of double C spring, upon the top of which the weight of the body is supported by the great muscular slings formed by the *serratus magnus* and the *levator anguli scapulae*. The scapula is long and narrow, and there is no clavicle. The head of the humerus looks backwards, and the distal articular surface of the bone is completely ginglymoid. The two bones of the *antibrachium* are ankylosed and the shaft of the ulna becomes exceedingly slender and its small distal end is distinguishable only with difficulty.

The muscles in the neighbourhood of the elbow and the shoulder of the horse, owing to the angle at which the bones are set, show a plicated spiral arrangement. This arrangement tends to procure the greatest possible strength with the least possible material, and insures symmetry with accuracy of movement.

In the anatomy of the human elbow joint, which is a compound joint (trochoginglymus), a number of points should be kept in mind. The lower end of the humerus becomes broader and thinner and curves forward in relation to the shaft. The obliquity of the articular surface makes the outer condyle higher and more forward in comparison with the inner condyle. The lateral portion of the articular surface is of a spherical shape, with an angular value of  $180^\circ$ , while the angular value of

the head of the radius is  $40^\circ$ , which determines a movement range of  $140^\circ$ . This capitulum has a well-marked groove separating it from the trochlea, an hyperboloid having an angular value of  $330^\circ$ , which is accurately adapted to the articular portion of the coronoid and olecranon. The angular value of the sigmoid notch of the ulna is  $190^\circ$ , which again determines the movement range at  $140^\circ$ . This movement range is not truly hinge in type. Owing to the shape of the trochlea there is a slight lateral shift in extension and a slight medial shift in flexion; therefore motion is strictly helicoid. But these deviations may be disregarded. It is nevertheless of interest to note that Pettigrew has shown that in the quadruped the articular surfaces of the elbow, ankle and cancanco-astragalar joints are spirally warped, acting after the manner of screws, and the limbs as a whole are twisted levers with the ridges and muscles spirally arranged. This enables the higher animals to apply their travelling surfaces to the media on which they are destined to operate, at any degree of obliquity, so as to obtain a maximum of support or propulsion with a minimum of slip. If the travelling surfaces of animals did not form screws structurally and functionally, they could neither seize nor let go the fulcrum on which they act with the requisite rapidity to secure speed.

The obliquity of the lower articular surface of the humerus and the conformation of the trochlea establish the carrying angle of the arm, which is  $10^\circ$  to  $15^\circ$  in the male and  $25^\circ$  in the female. The angle disappears in flexion. The carrying angle is cloaked in pronation and the hand is carried to the face, whereas in supination it is carried to the outer side. Voluntary flexion and extension are limited by the tension of the soft structures and not by bony contact, which occurs only in forced movement. Since the articular surface faces somewhat forward, extension is really hyperextension. A deep fossa posteriorly on the humerus accommodates the olecranon in extension, and the head of the radius and the coronoid process occupy depressions anteriorly during flexion.

It is to be noted particularly that the ulna is functionally the continuation downward of the humerus, to which it has precise adaptation, enabling stability. This leads to the relative infrequency of fractures of the internal condyle, and, when this fracture does occur, generally prevents gross displacement. The radius has poor stability on the humerus, but is functionally the upward continuation of the hand, so that in a fall on the hand the outer condyle receives greater force than the inner, even with allowance for the action of the interosseous membrane, which might be regarded as an articular ligament. The carrying angle further contributes to this fracture.

Finally, the occasional presence of the supracondyloid process is to be kept in mind.<sup>(3)(4)</sup> This hook-like process, which has a frequency of 1%, projects downwards and inwards from a point about 7.5 centimetres (three inches) above the joint line and in front of the medial epicondyloid ridge. From

its extremity there runs a fibrous band, which in rare cases may be ossified, to the medial epicondyle. Dwight records a complete bony tunnel (normal in *Felis leo*) through which passed the nerve and artery. A fracture of this *processus supracondyloideus* is described by Lund.<sup>(5)</sup> It is recorded here lest its presence be confused with commencing *myositis ossificans*, which will be discussed later.

This close and extensive coaptation of the ulna to the humerus, as compared with the reverse conditions at the radial side of the joint, is protected by a powerful medial ligament, which is the register of strains consequent upon the carrying angle. The weaker lateral ligament functions further away from the ulnar humeral joint. The internal lateral ligament is the more important, and in the experiments of Fessler<sup>(6)</sup> has been shown to possess a resistance to strains up to at least 100 kilograms, while the corresponding figure for the external lateral ligament is 80 kilograms, and for the anterior part of the capsule 70 kilograms. Flexion, extension and lateral displacements are limited by the lateral ligaments. Effusions of the elbow joint present on each side of the olecranon.

In the interpretation of radiographs the centres of ossification of epiphyses are of importance. The ossification of the capitulum is the first to appear, at three years, followed by the internal epicondyle, at five years. Then there is a wide gap to the eleventh year, when the trochlea appears, followed by the external epicondyle at thirteen years. The epiphyseal line lies just above the epicondyles, and a downgrowth of the shaft separates the medial epiphysis from the other three centres, which fuse together and join the shaft at puberty, to be followed by the medial epiphysis a year or two later. The lower epiphysis cannot therefore be separated later than the sixteenth year, and before epiphyses appear in your children patients diagnosis rests on clinical observations.

Fortunately the landmarks in surface anatomy are of great practical importance. In extension a transcondylar line passes over the tip of the olecranon and in right-angle flexion the olecranon lies 1.25 centimetres (half an inch) below this line and a little nearer the internal condyle. It is only when the swelling is severe that these landmarks may be obscured.

#### Fractures of the Lower End of the Humerus.

From the wide field of injuries to the elbow joint the discussion has been limited to fractures of the lower end of the humerus and their complications.

Of the last fifty cases of fracture of the lower end of the humerus, in the region of the elbow joint, treated at the Royal North Shore Hospital, the distribution was as follows:

Supracondylar fracture .....	34 (48%)
Fracture of the medial condyle .....	1 (2%)
Fracture of the medial epicondyle .....	11 (22%)
Fracture of the lateral condyle .....	5 (10%)
Fracture of the lateral epicondyle .....	1 (2%)
"T", "Y" and comminuted fractures ..	6 (12%)
Fracture of the capitulum .....	2 (4%)

Since nerve involvement is a not uncommon complication of fractures round the elbow joint, it is of great importance that examination of the limb in this regard should be carried out both before and after reducing the fracture.

It is rare now to find reduction carried out without good radiographs in two planes. It is advisable also to carry out the procedure in close association with an X ray apparatus, in order that the position may be checked when necessary, and so that, with difficult cases, a very limited use of the screen may be had, with due safeguard.

#### Supracondylar Fracture.

Supracondylar fracture is a common injury, accounting for 48% of cases in the series under discussion; the age limit runs from two to eleven years, with an average age of six years. In a series recently reported by Naughton Dunn, the proportion of supracondylar fractures to injuries of the elbow is given as 50%, and the common age as eight to twelve years, the fracture being rare after fourteen years. This fracture is of two types, extension and flexion. Of these, the former is the more common, and occurs chiefly in children. The child has generally fallen on the hand with the elbow in extension.

In the extension variety the line of fracture runs from about the epiphyseal line in front, upwards and backwards, so that an oblique portion of the shaft remains attached to the lower fragment, which now lies behind and above its normal position. Rotation of the lower fragment in relation to the shaft may be present, also displacement to either side.

Flexion fractures are seen in the adult, caused by severe falls on the flexed elbow, the line of fracture running at right angles to that of the extension fracture, and the fragment being displaced forward. With the lower fragment intact it does not occur in this series; but if comminuted types be included it forms 12%.

Kellogg Speed,<sup>(7)</sup> in the recent edition of his book, states that the mechanism of supracondylar fractures is a fall on the hand or forearm, with the elbow flexed, or direct violence on the arm above the elbow, and that 60% occur in children under fifteen years, notwithstanding the risks of the motor car and industry. He mentions burglars as being particularly subject to these fractures, as a result of a fall from a height, jumping from a window, or from the sharp tap of a policeman's hickory club on the elbow. The use of the elbow is impaired and the criminal can never again shoot straight. It is not stated whether the burglar is entitled to redress for subsequent professional incapacity. Obviously they do not seek expert advice. It is clear that occupational therapy has its limitations and that we cannot infer the incidence of this fracture in that city, since the figures for burglary in Chicago are not given.

The clinical examination of the recent elbow fracture must be carried out with due regard to



the knowledge that nerve trunks may be in close proximity to sharp edges of bone. Exact knowledge of the lesion must be obtained at some time in all cases by X rays. With easy radiological access, the clinical examination may often be confined to the soft parts, with particular attention to the nerves and distal circulation and any complaint by the patient. But in some cases diagnosis may be desired when the patient is first seen. If the swelling be not great, the surface anatomy of the elbow joint may be verified as normal, and if full extension is possible, lateral mobility is present in both directions, and the only likely confusion is backward dislocation.

An anæsthetic is generally advisable, and if the patient is seen early a local anæsthetic is widely used. The method of reduction, with variations, is well recorded and needs little discussion here, except to emphasize the necessity for care of the soft parts. I invite discussion on the practice of pressing away the swelling by firm pressure after a reduction as advocated by Böhler.<sup>(8)</sup> It is extremely difficult to maintain reduction while attempting to press away a swelling which surrounds the whole elbow. To do this in the presence of partial reduction admits the possibility of damage, and many reductions are short of perfection. Furthermore, in the few cases in which I have attempted the procedure I have produced but little effect on the swelling. Effleurage, which has some effect reflexly in the diminution of swelling, is not aimed at, and in Böhler's description emphasis is placed on the mechanical effect of firm pressure. In such a manœuvre, what is the exact effect on the extravasation of blood? There is another aspect for consideration. Where a skin plaster is to be applied, the corrected position will be more readily maintained if there is coaptation to bony landmarks, so that any diminution of swelling will be an advantage in this regard. Where a skin plaster is applied over any remaining swelling, either the swelling subsides and the skin detaches from the plaster, which is then larger than the limb at the site of the lesion, or the skin remains attached to the plaster and perpetuates the size of the limb at the time of application.

There is no doubt about the value of immobilization maintained with a minimal restriction of functional use. In the healing of fractures internal stress on the bone (Gaenslen<sup>(9)</sup>) may be brought about by muscular contraction, and such dynamic stress may far exceed the static stress. Jansen brings evidence to prove that, contrary to Wolff's law, bone is laid down, not in response to trophic stimuli of both tension and pressure, but to pressure alone; and Gaenslen has shown that fibrous tissue interposed between fracture surfaces can be transformed into bone or replaced by bone if the shearing force is eliminated.

Skin plasters in general are to me most efficient in maintaining reduction when there is only slight swelling. For this reason, in certain cases where

swelling persists, it appears to me an advantage to use a separate skin mould on front and back, with crêpe pressure, and to take up slack as necessary; for example, as in a Colles's fracture.

The present series contains twenty-four recent cases of supracondylar fracture, and in twenty-two of these there was a full functional result. Of the remaining two, in one there was a minor limitation of extension, and the other was a crack fracture in an adult who sustained a moderate degree of limitation of extension, obviously due not to his fracture, but to injury of the soft parts combined with the factor of age. These patients were all treated after reduction by the cuff and collar method with flexion, no other bandage or accessory splint being used. This small series did remarkably well without an attempt being made to remove œdema. This limited analysis does not disclose to me any reason for the necessity of the manœuvre as a routine measure in simple, straightforward cases of fracture, where the cuff and collar method can be used to maintain reduction.

Eikenbary<sup>(10)</sup> reports the end results in a series of 51 cases of recent supracondylar fracture. Full function was present in 44 of these, and in the remaining cases there was limitation of movement.

The original "cord gauge halter" was used by H. O. Thomas<sup>(11)</sup> in a wide variety of lesions at the elbow joint. Thomas did change for a period to a "rigid halter", but returned to the original type.

It is presumed, where the method is used in the presence of marked swelling, that flexion is not pushed to the point of circulatory interference, and is increased *pari passu* with the diminution of swelling, until a position of about 35° of flexion is obtained, which is a little short of full flexion. It is to be stressed that this method of splinting, or rather absence of splinting, does not in itself reduce the fracture; this must be done *secundum artem*, and the forces of pressure and counter-pressure maintained until the desired flexion is achieved.

The deformity which I have found occasionally to be most difficult of reduction, when present, is rotation of the lower fragment in the long axis of the humerus. Any method of flexion applied without reduction of the displacement is a most frequent cause of ischæmia.

When should this fracture be reduced in the presence of marked swelling? I omit from consideration the possibility of pressing away this swelling. Such a fracture should still be immediately reduced; but there should be close subsequent control and variation of the degree of flexion. The degree of flexion in any elbow fracture should be appreciably less than the maximum attainable. In forty years of intensive practice Robert Jones<sup>(12)</sup> did not have any personal experience of ischæmic paralysis after fractures round the elbow joint treated without delay by this method. Nor did he practice the manœuvre of firm pressure on the swelling. It is well established that ischæmia may

occur in the absence of any handling or treatment; but most authorities are agreed that its most frequent accompaniment is non-reduction of the displacement, followed by the flexed position.

Eikenbary saw within a three-year period before 1928 twenty-one cases of Volkmann's contracture, in every one of which there had been a persistent posterior displacement, and all the patients gave a history of having the arm put up in rather acute flexion and of having a good deal of pain following the application of the splints.

With the extension type of fracture, practically unknown in the adult, ischæmia occurs typically in the age period for the supracondylar fracture in the child. There is no general agreement as to the immediate causation of typical ischæmia; but in the uncomplicated case there is much evidence pointing to venous blockage. In other cases there may be nerve compression as well.

It would appear that muscle tissue withstands deprivation of nutrition, such as occurs in devascularization of a limb by the use of a rubber bandage tourniquet applied progressively from below, better than continued complete venous stasis. It is more difficult to starve muscle tissue than to poison it.

Paul Magnuson<sup>(13)</sup> states that the placing of the elbow in flexion in anticipation of a possible ankylosis seems to be so firmly fixed in the minds of medical men that they forget that the fracture is a secondary consideration if the pressure is sufficient to cause interference, and until they are sure there will be no interference the arm should temporarily be put in extension, preferably with traction.

Kellogg Speed<sup>(14)</sup> agrees that when there is a threat of Volkmann's ischæmic paralysis because of incomplete reduction, too tight bandaging or too great extravasation of blood within the tissues, incision in the front and lateral aspect of the forearm down through the superficial fascia may be required to relieve pressure. Ordinarily, when this paralysis threatens, removal of the splint, loosening of the dressing, and slight increase in the extension of the forearm will be sufficient to avoid disaster.

Other than in the remote contingency of ischæmia's commencing from the time of fracture due to circumstances beyond our control, such as the severance or occlusion of the venous supply, the typical lesion must be very rare in cases which have been carefully observed during the three days following reduction. Mild degrees of ischæmia are relatively common and frequently escape diagnosis. It is strongly desirable that such elbow fractures should be under trained observation during this period, and preferably written instructions should be given as to the observations desired and action to be taken.

If there is evidence of some interference with the circulation, such as severe pain, numbness or swelling, when the fracture has been well reduced, extension at the elbow should be increased. With persistence of symptoms there are alternative courses. Zeno's arrangement of Kirschner traction wire through the olecranon, with the arm overhead

in bed, appears an ingenious device; but if the signs are of graver significance the safer procedure is evacuation of the blood clot, for which an antero-medial incision in the antecubital fossa may be used.

Whenever Kirschner wire traction is used, particularly in the olecranon, it should be discontinued as early as possible. Böhler states in this regard that thrombosis may occur if there is too long a delay in reduction; but he advises the application of continuous traction, as in Zeno's method, when his routine of unpadded plaster and elevation of the arm does not suffice. In the causation he includes the application of the case to the supinated arm. He does not favour incisions in the deep fascia.

The following important case, in which the patient was under close observation, furnishes some evidence of value.

A child, aged six years, was admitted to the Royal North Shore Hospital on March 7, 1936, with an elbow stiff in slight flexion except for a few degrees of movement. There was a history of supracondylar fracture on September 4, 1935, and two attempts at reduction on the two following days. A radiograph showed a firmly united fracture, with some backward displacement and the lower pointed end of the upper fragment blocking movement. The projecting angle of bone was removed through a medial incision. This immediately allowed an unrestricted full passive range. (The advisability of this procedure in preference to an osteotomy along the old line of fracture, or other measure, or leaving it quite alone, is not for discussion here.)

In this particular case there was no recent fracture. Before operation the limb was otherwise normal, with unimpeded blood and nerve supply. After operation there could be no question of displacement, since the firm union was left untouched. The antecubital space was larger than it had been before, and the subsequent radiograph showed good lateral relationship. The procedure anatomically is a simple one. The arm was left in slight flexion.

For three days the appearance of the forearm was normal and there was no unusual complaint by the patient. On the fourth day signs and symptoms of impending ischæmia began to appear. The dressings, other than a sterile towel, were removed, the elbow was allowed to resume a comfortable degree of extension, and the limb was elevated. There was definite diminution of swelling of the forearm and hand; the radial pulse was stronger; colour improved and pain was absent. After a period of twenty-four hours, during which conditions were unchanged as to the posture of the elbow and elevation of the limb, there was an aggravation of symptoms, and it was obvious that ischæmia would develop.

Under general anaesthesia the wound was reopened and a large amount of blood clot was removed. There had been secondary hæmorrhage, which necessitated ligation. The pulse returned, the change of colour was immediate and the swelling began to diminish. There was no subsequent trace of ischæmia.

There was no fracture to interfere with the blood or nerve supply, and after the operation there was no bone displacement to cause interference. The posture of acute flexion was not used and the relapse occurred while there was no bandaging of the limb and the limb remained elevated. The secondary hæmorrhage appears to have been the sole cause of the symptoms.

Fairbank<sup>(15)</sup> speaks of the radial pulse as a most useful guide. If the venous block is complete, obliteration of the radial pulse does not necessarily follow. Nor does the presence of the radial pulse indicate that arterial blood is flowing into the fore-



arm to any appreciable degree. The impulse continues when we obliterate the radial and ulnar arteries in estimating the pulse rate. Fairbank speaks of cases in which the radial pulse may not be felt and yet no symptoms of ischaemia arise. In one case the radial pulse was not felt for some days, and then only intermittently, and yet the case ran a smooth course. It seems possible in such cases of arterial block that there may be less impediment in the venous return, so that there is partial starvation but not poisoning.

No treatment other than that of rest is desirable after reduction of this fracture in children until union of the fragments is firm; this begins to take place after about three weeks. As the swelling subsides, the halter should be tightened. At the end of three or four weeks the halter may be dropped an inch or two and the patient allowed this range of active movement. If free movement obtains at the end of a week, a further extension is allowed. The process is repeated until a right angle is reached, when the patient may be left to pursue active movement unrestricted. Instructions to carry weights should not be given. The patient can best increase his range by active contraction of the triceps. Weight-carrying is a form of passive resisted movement, and passive movement is accompanied by apprehension. Active movement leads to cooperation, with reciprocal innervation as an ally.

*Myositis Ossificans.*—*Myositis ossificans* may occur in spite of any treatment and should be looked for in all cases in which progressive increase in range of movement does not follow voluntary use. Pain on movement may be severe. Radiography provides conclusive evidence. Passive movement increases the formation of new bone. Rest must be continued until the process has run its course.

I have seen *myositis ossificans* at the elbow joint in a man suffering from fracture-dislocation at the shoulder joint, in which good position at the shoulder had been obtained, with the arm on an abduction splint of plaster of Paris. The patient complained of much pain in the shoulder and arm. The soft parts, on removal of plaster after a period of six weeks, were in good condition; but in spite of the rest position in right-angle flexion at the elbow, the condition of *myositis ossificans* became apparent.

#### "T", "Y" and Comminuted Fractures.

In some "T", "Y" and comminuted fractures there is little displacement of fragments, or they can be sufficiently reduced and held by the simple method of cuff and collar. These are generally direct fractures of the elbow joint. There is great swelling, and on palpation one gets the effect of feeling a bag of bones. The majority of them are extremely difficult to reduce and are frequently followed by serious impairment of function. Open reduction is a difficult procedure and in general gives an unsatisfactory result, due to the comminution of bone, the thinness of the lower end of the humerus antero-posteriorly, the necessity for wide and multiple incisions, the possibility of ossification in injured ligaments, and the danger of sepsis in the presence

of severe trauma. If conservative reduction is not adequate, it is better as a rule to do a late-stage operation. Seven such cases are recorded in the present series, and in four of these the patients were over seventy years of age. Osteoarthritis is not uncommon as a complication.

I have as a rule used Magnuson's method of reduction in these fractures; but in cases of great swelling, skeletal traction with elevation of the limb may occasionally be necessary.

An interesting case is recorded where late ulnar palsy followed an old comminuted fracture. This history was written in a facetious manner by the patient himself, and includes the following portion:

Social environment: Works hard day and night.

Sexual history: Engaged.

Then follows a brief description of the ulnar palsy, with a statement that the patient is a suitable subject for anaesthesia. But the history has relevance. It is, of course, well known that an increased carrying angle may exist without incapacity for twenty years or more, and ulnar palsy may then follow vigorous flexion.

#### Fracture of the Capitulum.

Two cases of fracture of the capitulum are recorded. The patients were adults. Neither of them responded to the manoeuvre of hyperextension plus varus, with pressure on the fragment. In both cases open operation was performed. In neither could the result be classed as good, though excellent anatomical relationship was established. In one of them no fixation was necessary; but in the other a small countersunk ivory peg was used. Excision may be the best treatment in the adult.

#### Fracture of the Lateral Condyle.

Fracture of the lateral condyle occurred in five cases. Conservative treatment was employed. The mechanism is such that the fragment must contain portion of the metaphysis. The fracture more commonly follows force applied through the hand with the elbow in flexion, the force being transmitted through the radius; but it is occasionally due to avulsion towards a varus position when the elbow is nearly extended. In children the fractured portion generally contains only a flake of the diaphysis adjacent to the capitulum.

Fracture of the lateral condyle frequently responds to manipulative reduction. For open treatment, when necessary, fixation by simple suture or wiring is described.

My experience of the open reduction for fracture of either condyle is that the procedure can be a very difficult one. The results in general have not been as good as those obtained in "T" or "Y" fractures treated conservatively.

There were three late cases.

One patient, aged thirty-five years, presented herself with an advanced late ulnar palsy and a history that her fracture had occurred thirty-one years previously. The arm had not had any heavy work until thirty years after

the fracture, when misfortune compelled her to undertake work as a cleaner. There was a pronounced increase of the carrying angle and upward displacement of the lateral condyle. Though the paralysis was severe, full recovery followed transposition of the nerve.

A late ulnar palsy was seen also in one other case, eight years after fracture of the lateral condyle, and in one case of comminuted fracture which had occurred about twelve years previously. In each case anterior transposition was carried out. Where increase in the carrying angle has resulted in ulnar palsy the final factor in inducing paralysis has been vigorous or continuous flexion of the joint.

P. D. Wilson<sup>(10)</sup> has discussed the frequency of non-union and fibrous union in these cases. A common cause assigned for the result is interference with the blood supply; but Wilson states that if there is correct reduction bony union always results. It is pointed out that if there is non-union the fragment continues to increase in size through the activity of the epiphyseal centre. Attention is also drawn to the strong ligamentous and muscular attachments to this fragment. Finally it is shown that late bone grafting is successful and that there is no reason therefore why bony union should not be obtained. Except in ulnar palsy, comparatively full power is present in non-union of the lateral condyle because of the ulna's functioning as the continuation of the humerus.

#### *Fracture of the Lateral Epicondyle.*

Fractures of the external epicondyle are uncommon and the treatment does not as a rule present difficulty.

#### *Fracture of the Medial Epicondyle.*

It must be remembered that separation of the epicondyle before the age of five will not be visible radiographically.

Fractures of the internal epicondyle form 24% of the cases seen at the Royal North Shore Hospital of Sydney. The usual percentage of incidence is about 16, and the average age about twelve years. A considerable number of patients seek advice on account of late complications. The centre of ossification appears in the fifth year and fuses about the age of sixteen years. Separation takes place at the epiphyseal line. The internal lateral ligament and the group of flexor muscles are attached to the epicondyle, so that a forcible increase in the carrying angle may cause avulsion and sometimes also dislocation of the joint. Fibrous union frequently follows manipulative reduction and even open fixation. Results of conservative treatment are in general fairly satisfactory, but there is occasionally some limitation of function and sometimes interference with the ulnar nerve. In the first type there is little or no displacement.

S. L. Higgs has given a series in which 50% of cases were accompanied by downward displacement of the fragment. In these he advocates operative fixation, since in his experience joint stability, weakness and ulnar neuritis are not uncommon late complications. Two cases of late ulnar neuritis for

which transposition was required occurred in this series.

In the third type of displacement the epicondyle enters the joint. In such an event it might be impossible to reduce the dislocation without open operation. Manipulative reduction may be possible for forcible increase of the carrying angle with dorsiflexion of the wrist and fingers. In this way the pull of the flexors may be sufficient to free the fragment from the joint. When operative reposition is performed, it is better to place the nerve where nature might have put it originally.

Strong support for open reposition is given in a very full discussion of the late results by Osmond Clark, in a paper read before the British Orthopaedic Association but not yet published. Since writing this paper Clark states that further experience is convincing him that manipulative success is greatest within a few hours of the injury. He records 166 cases of fracture of the internal epicondyle out of a total of 919 elbow-joint fractures; imprisonment of the epicondyle occurred in 22 of these. Dislocation into the joint occurred in 12% of the epicondylar fractures.

This complication occurred in one of the twelve fractures of the medial epicondyle in the Royal North Shore Hospital series. The fragment was removed, a useful joint resulting.

#### *Summary.*

1. Comparative anatomy has been briefly sketched in view of its interest, the resultant perspective and the availability in Australia of unique fauna in this regard.

2. The simplest method of retention after reduction of most fractures of the lower end of the humerus involving the elbow joint is by cuff and collar alone, and this method suffices in the vast majority of children and in many young adults.

3. Methods of traction for limited periods, on the pronated forearm with the elbow at a right angle, will sometimes prove effective in gross fractures not retained by cuff and collar.

4. Traction by Kirschner wire or similar skeletal device should be used only when the former methods are inapplicable.

5. Elevation helps in diminution of swelling and is often best carried out in recumbency.

6. Examination for nerve involvement should be made before and after reduction.

7. *Myositis ossificans* may be entirely due to the original trauma at the time of fracture. The only other likely method of production is passive or forcible movement in after-treatment.

8. Ischemia may be due to external or internal pressure, and may be entirely due to the trauma at the time of fracture. The other common method of production is flexion without reduction.

9. The function of the elbow is closely associated with the prehensile function of the hand, so that where limitation is inevitable, the elbow for general purposes should be slightly more flexed than a right



angle in cases of inevitable ankylosis, or should include that position where limited movement is possible.

#### Acknowledgement.

I desire to acknowledge the special help of the Director of the Institute of Anatomy, Canberra, in regard to the anatomy of the elbow joint.

#### References.

- <sup>(1)</sup> Sir Wm. Colin MacKenzie: "Intellectual Development and the Erect Posture", page 17.
- <sup>(2)</sup> W. K. Gregory: "Notes on the Principle of Quadrupedal Locomotion and on the Mechanism of the Limbs in Hoofed Animals", *Annals of the New York Academy of Sciences*, Volume XXII, October 18, 1912, pages 287 to 294.
- <sup>(3)</sup> George S. Huntington: "Modern Problems of Evolution, Variation and Inheritance in the Anatomical Part of the Medical Curriculum", *Anatomical Record*, Volume XIV, Number 6, June, 1918, pages 359 to 445.
- <sup>(4)</sup> R. J. Terry: "A Study of the Supracondyloid Process in the Living", *American Journal of Physical Anthropology*, Volume IV, 1921, page 140.
- <sup>(5)</sup> Henry J. Lund: "Fracture of the Supracondyloid Process of the Humerus", *Journal of Bone and Joint Surgery*, October, 1920, page 925.
- <sup>(6)</sup> J. Fessler: Quoted by A. Steindler: "The Mechanics of Normal and Pathological Locomotion in Man", page 315.
- <sup>(7)</sup> Kellogg Speed: "Fractures and Dislocations", Third Edition, 1935.
- <sup>(8)</sup> Lorenz Böhler: "The Treatment of Fractures", Fourth English Edition, page 132.
- <sup>(9)</sup> F. J. Gaenslen: "The Role of Physical Therapy in Orthopaedic Surgery", *Journal of Bone and Joint Surgery*, July, 1936, page 559.
- <sup>(10)</sup> C. F. Eikenbary: "Fractures of the Elbow", *Journal of Bone and Joint Surgery*, October, 1928, page 757.
- <sup>(11)</sup> H. O. Thomas: "The Upper Extremities", page 82.
- <sup>(12)</sup> Sir Robert Jones: "Injuries about the Elbow in Children", *The British Medical Journal*, April 23, 1932, page 739.
- <sup>(13)</sup> Paul Magnusson: Personal communication, April 13, 1936.
- <sup>(14)</sup> Kellogg Speed: Personal communication, April 17, 1936.
- <sup>(15)</sup> H. A. T. Fairbank: "Supracondylar Fracture of the Humerus", *The British Medical Journal*, March 7, 1936, page 501.
- <sup>(16)</sup> P. D. Wilson: "Fracture of the Lateral Condyle in Childhood", *Journal of Bone and Joint Surgery*, page 301.

#### FRACTURES AROUND THE ELBOW JOINT.<sup>1</sup>

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WE are fortunate tonight in having the opportunity of discussing a very common condition, of practical importance to every member of the British Medical Association.

I appreciate it as a very high honour to have been invited to be one of the two openers of the discussion, and I look forward with keen interest to hearing the various views on the subject. From being almost standardized for many years, the subject has again become highly controversial, since the strong advocacy by the Austro-German school of revolutionary views and methods. These relate both to mechanical reduction and to retention by traction and elevation, on lines analogous to those we have long been familiar with in the lower limb.

As time is limited to twenty minutes, Dr. Scougall and I have agreed that I shall employ the time in discussing the general problems and principles peculiar to the whole region of the elbow joint and in showing some apparatus, whilst he discusses some problems of the particular types of fracture.

<sup>1</sup>Read at a meeting of the New South Wales Branch of the British Medical Association on October 29, 1936.

#### DEFINITION.

What is a fracture around the elbow joint?

It is not only a broken bone or two, with torn ligaments, muscles *et cetera*, and with œdema and blood present. Excluding the very rare condition where the elbow alone is crushed between two solid surfaces, it is a condition where some great force has been applied to hand or elbow, been transmitted through all the joints and bones of the limb, and has met resistance where the shoulder girdle rests on the trunk. A severe strain or even sprain has occurred at every joint, in addition to local injuries at the point of impact. Finally, one or more of the bones break somewhere, in this case near the elbow joint. Thus we have: (i) strain or sprain of all the involved joints, (ii) fracture or dislocation at a particular spot, (iii) injuries of muscle, nerve or vessel, due both to displacement of bone and to the original impact.

#### SIMPLE FRACTURES.

##### The Recognition of Multiple Injuries (Principle Number I).

The cracking and displacement of the bone is the dramatic event, which can be visualized and palpated and observed radiographically; but it is essential, if good results are to be obtained, especially in patients over forty years of age, to visualize injuries of multiple joints and tissues, in the treatment of which the reduction of bone displacement and the retention of fragments in the position obtained are only one important factor. Particular attention should be paid to the examination of the bicipital groove, as tenderness here (often overlooked) may indicate a tear of the interosseous fibres holding the biceps in position.

The first ideal of treatment would then allow for active movement throughout, of the fingers, wrist, and shoulder joint, and correct placement of the biceps tendon. In children, with their lighter limbs and rapid repair, this is not only easier, but less vital. But in the adult, with more massive limbs, less rapid repair, and, from their greater weight and height, more severe traumata, it is not only more difficult, but more vitally necessary. To this the large numbers of compensation patients testify, spending, as many of them do, months or a life-time repairing stiff and painful shoulders, wrists and fingers after the elbow is well.

##### The Mid-Position of the Joints (Principle Number II).

I now come to a consideration of Principle Number II: Joints are best rested in and most easily and painlessly exercised from the mid-position.

I. *The Shoulder*: The arm can be raised 180° with the aid of the shoulder girdle muscles, and the forearm moved through 140°, so that a horizontal arm with forearm at 110° is in mid-position. The shoulder of the average adult at 40 years of age can be moved horizontally 20° behind the frontal plane and 100° in front of it, so that 40° forward of the frontal plane is mid-position at this age.

II. *The Forearm:* With the shoulder and elbow in mid-position, the average adult forearm can be supinated from the horizontal about  $80^\circ$  and pronated about  $90^\circ$ .

III. *The Hand:* The dorsum of the hand can be extended about  $80^\circ$  and flexed to about  $60^\circ$ . So that the mid-position of hand and forearm is attained with slight pronation and slight dorsiflexion of the hand—the natural position assumed by the loosely closed hand resting on a level surface.

The second ideal of treatment would then allow, in injuries of these joints, of nursing the shoulder horizontally and  $40^\circ$  forward the elbow at  $110^\circ$ , forearm, hand and fingers as though resting on a horizontal plane with fist loosely closed. The retentive apparatus, ideally designed, would allow for free active movement from these positions as soon as possible. The necessity of retention of the fracture may not, and at present will not, allow the ideal. But any retentive apparatus that allows a closer approximation to this ideal at least claims very serious consideration before we reject it for another.

#### Reduction and Retention (Principle Number III).

Exact anatomical reposition and retention best favour rapid healing, lessen serum collection and œdema, prevent deformity and favour resumption of function. Although the elbow is a hinged joint, it is by no means a simple transverse hinge. Three points especially have to be borne in mind: (1) The medial condyle is the lower of the two, allowing a carrying angle. (2) The lateral condyle, besides being higher, is forward of the medial, allowing the radial head to slide around it. (3) The lower 7.5 centimetres (three inches) of the humerus are flattened and recurved forwards 1.25 centimetres (half an inch), to allow room in flexion of the elbow for muscles and vessels, without pressure. The joint surfaces are directed about  $40^\circ$  forward of the vertical.

This brings us to the very vexed question of the ideal method of reduction and retention—shoulder in abduction or by the side, elbow in flexion or at right angles, with or without continuous extension, and, when extension is needed, by the weight of the forearm, as in the collar and cuff method, or by traction from the forearm itself, or by traction from a pin or wire through the olecranon. In my opinion, each has its place, its advantages and its drawbacks, which the severe limits of time prevent discussing in detail. But some general considerations are not out of place.

#### *The Flexed Position.*

I. The flexed position, with the palm facing the shoulder, makes the forearm the mirror image of the arm. It pulls the recurved end of the humerus forwards and holds the condyles down to the required level for the carrying angle. But to do so it depends on the pull of the medial and collateral ligaments, through an intact ulna and orbicular ligament, combined with a tense triceps.

II. The flexed position prevents flexion displacement of the short lower fragment, or of the condyles separately. But supination causes a stretching of the pronator-flexor muscles, which will cause valgus of a loose medial condyle.

III. To be effective, flexion must really be hyperflexion. Now any one of us can voluntarily abolish the radial pulse by hyperflexion, so that the method needs great skill and judgement in the placing of pads to a point almost midway between elbow and shoulder, and in securing the hyperflexion by bands distal to these. Where there is much œdema, hyperflexion may be at first impossible without serious circulatory interference and resultant stiffness of fingers, wrist and forearm—Volkmann's contracture and lesser but analogous contractures.

IV. An injured elbow can be nursed equally as well with this as with other methods, on the abduction splint which I have devised (Figure I).



FIGURE I.

Flexed supinated position, with elevation on author's "clavicle-to-elbow" splint, being exercised. Hand fixed by screws at 1, 2 and 2', abduction movements by relaxing screw 3. Note at 4 sliding loop for traction cord for reduction or continuous traction.

*Summary:* The flexion method: (i) is simple and effective, except in extensive injuries destroying the fulcrum of the ulna and collateral ligaments or preventing the tensing of the triceps muscle, as in comminution of the humerus; (ii) carries grave risks of circulatory block; (iii) needs constant personal attention until œdema is lessened; (iv) is suitable in nearly all cases in children and in less muscular women, especially in transverse or T-shaped or Y-shaped fractures or those of the radial head and neck (to be of any value, therefore, any compared series of results must record the age of the patients and the sex of adults); (v) does



not preclude the use of ambulatory abduction in a suitably devised splint.

#### *Traction by Wire or Pin.*

I. The actual added trauma and risk of sepsis due to the wire employed in traction reduction is almost negligible and has been made a boggy, mainly by those who are unfamiliar with it.

II. It allows easy, continuous traction, with the surgeon's hands free and no relaxing and relapsing of partly reduced fragments (Figures III and IV). This is particularly valuable when the arm has been shortened by extensive comminution, or in compound fractures, when every manipulation increases the risk of sepsis. In my hands it has allowed easy and rapid reduction in cases that I had failed utterly to reduce by other methods.

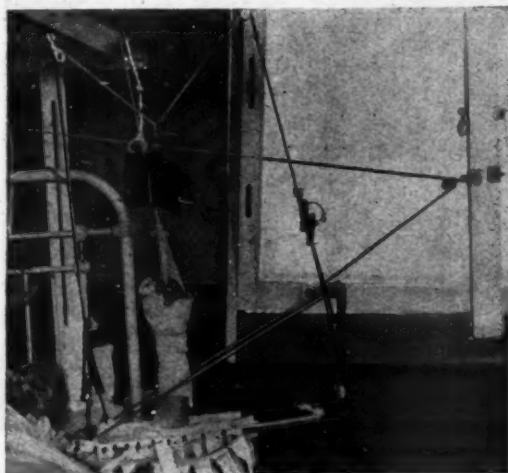


FIGURE II.

Continuous traction in Corlette's gallows. Corlette's method, author's "universal splint". Arm cradled on bandage, extended by adhesive plaster (or olecranon wire as required) to distal end of splint, the extension of the latter by cord and weight at bed-head. Free movement in bed, no shoulder ring indicated in age, infancy, and heart and lung conditions.

III. The line of pull is necessarily in the line of the humerus. This results in loss of the forward curve of the humerus, which, if not corrected during the application of plaster, or by flexion after reduction, results in slight loss of flexion and apparent over-extension at the elbow joint; but this is of no functional moment. If continuous traction by wire or pin is used, the forearm must be kept at a right angle, because in flexion it causes considerable posterior sloping of the lower humeral fragment. Even this might be of small moment when balanced against anatomical retention or avoidance of sepsis.

IV. Traction by wire or pin does not automatically care for the carrying angle. This needs careful attention by the surgeon, and the fluorescent screen is a valuable aid. I have devised a stirrup (Figures III and IV), in which the relative lengths of the arms and the angle of pull relative to the long axis of the arms are both easily adjustable. This enables

the surgeon to make a direct pull on a wire driven obliquely, or to deviate the short fragment at will by pulling on a transversely placed wire from a hook-off centre.

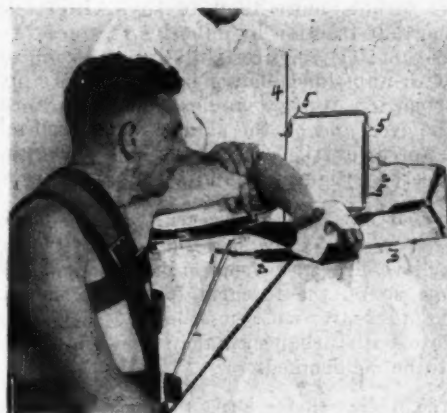


FIGURE III.

Illustrates mechanical reduction for ambulatory patients, limb remaining in position later. Author's "universal" stirrup, carrying alternately pin wire or hook. 1: sliding loop; 2: spring scales; 3: turnbuckle; 4: Kirchner's wire; 5, 5<sup>1</sup>, 5<sup>2</sup>: set-screws for adjusting length of either side, width, or position of loop.

*Summary:* (i) Wire or pin traction enables reduction in those cases which cannot be reduced by manipulation; (ii) it holds the parts comfortably in place during the application of plaster; (iii) it has an especial field in grossly comminuted fractures and in compound fractures, where minimum trauma is desired; (iv) when retention cannot otherwise be maintained, it can be continued either

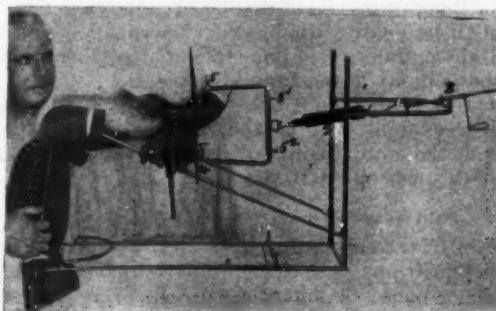


FIGURE IV.

Illustrates mechanical reduction by universal splint for patients to remain in it as in Figure I. Key numerals as in Figure III. Hand supported on author's "adjustable hand", which can be adducted, pronated, flexed, or placed to suit any length of arm or forearm.

in bed with weight and pulley (Figure II), or on the abduction frame with spring traction; (v) it requires X ray control to avoid over-traction, loss of forward humeral curve or distortion of carrying angles; (vi) but it may be used to secure fair reduction and comfortable retention pending refer-

ence to X ray control; (vii) it is best carried out while the limb is on the splint on which it is to be nursed.

*Traction by Adhesive Plaster from a Plaster Cast.*

Time forbids more than to say, without giving reasons, that traction by adhesive strapping from a plaster cast: (i) requires skill and care and experience with unpadded plaster splinting; (ii) involves full pronation at right angles, so that the pressure shall be even and on the skin of the dorsal surface of the forearm (the cast of the arm merely acting as a sleeve) (Figures V and VI).

*Traction from Adhesive Plaster or Bandage Round the Forearm.*

I believe traction from adhesive plaster or a bandage round the forearm to be so conducive to unequal pressure, with possible pressure sores and circulatory disturbance, that it should be mentioned only to be condemned.

*The Uncontrollable Short Fragment (Principle Number IV).*

Involved in the problem of accurate reduction and retention is the difficulty presented by the uncontrollable short fragment.

When there is a short fragment near a joint it is not controllable by external splinting.

At the elbow the flexor-pronator group of muscles is predominant. Retention in the flexed pronated position is therefore easiest, but has drawbacks, the principal of which is later limitation of movement, especially supination. This is largely eliminated by combining with it the next two principles of treatment—those of the position of circulatory ease and of nutritional exercise.

The advocates of the right-angled position with plaster traction find it necessary to adopt full pronation; even then displaced condyles usually have to be dealt with by open operation. For the medial condyle a similar difficulty is encountered in the popular flexed-supinated position.

In this connexion I should like to ask if anyone has ever used any method of local anaesthesia around the motor points of the muscles, comparable with the use of "A.B.A." at the *sphincter ani*.

*Pain as a Warning (Principle Number V).*

Pain in trauma is due to pressure in an unaccustomed position. It may be pressure by blood, lymph, tendon, bone or muscle, or by the retentive apparatus, and is evidence of some condition short of the ideal.

The fifth ideal in treatment, then, is that when the fracture has been reduced and the position retained, there should be no pain.

I have not succeeded in attaining my ideal; but I can remember with regret occasions when I have dismissed complaint of pain with an airy remark relating to the patient's nerves or the lapse of time, with subsequent sorrow to both the patient and myself. I believe that the ideal is practically attainable in almost all fractures, and I can say that

this principle has taught me more about the minor technique of fractures and saved more disasters than any other. I am so convinced of this that a routine instruction is given to both patient and nurse, that I am to be informed if there is pain requiring more than a simple sedative for sleep. I believe that if this ideal were maintained there would be no Volkmann's contracture.



FIGURE V.



FIGURE VI.

Active movement at shoulder without disturbing force of continuous extension in clavicle-to-elbow splint. Patient supine because with patient vertical the limb weight pulls against weight or spring traction when above the horizontal, with it when below.

*Circulatory Ease (Principle Number VI).*

Having now set the fracture so that it is reduced and the fragments are retained in good anatomical position, either in flexion or at right angles, we come to the sixth principle.



The position of circulatory ease, that is, the horizontal, or preferably a slight centripetal down slope, is the position that favours healing, reduces pain and prevents or minimizes œdema, with its vicious circle of circulatory obstruction, fibrosis *et cetera* (Figure IX).

Patients treated by hyperflexion are commonly nursed with the elbow dependent. The greatest danger of this method is circulatory embarrassment. In children, with their frail muscles and good circulation, œdema usually rapidly disappears and full movement of wrist and fingers becomes possible. But in any case of doubt abduction should be used. My rule of thumb for abduction is to use it: (i) in all cases of doubt; (ii) in all muscular adults; (iii) in all over forty; (iv) in children with marked œdema after four days; and (v) in all cases in which tenderness over the bicipital grooves suggests possible displacement of the biceps tendon.

I prefer an angle of abduction of  $100^\circ$  (from considerations relating to the subacromial bursa).

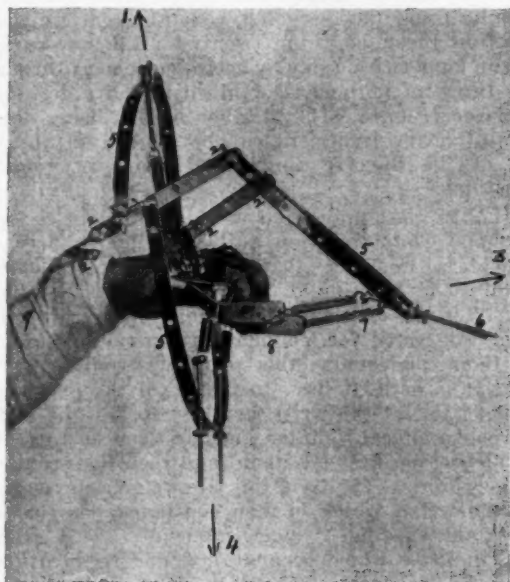


FIGURE VII.

First stage in treatment of Volkmann's contracture by author's hand splint. Arrows indicate: 1, extending flexed wrist; 4, flexing extended proximal phalanges; and 3, extending flexed distal phalanges; 2, prongs of the frame, carrying at any angle spring steel hoops (5), the latter carrying screws (6) and springs (7) of varying strength, which pull hoops (8) or washleather buckets; at 9 the frame, like a short, very broad tuning fork, is held secure by removable dorsal plaster cast and bandage.

#### Nutritional Exercise (Principle Number VII).

The limb is now "set" and the fragments immobilized in a position of circulatory ease. This brings us to Principle Number VII. Stiffness and wasting in and around an immobilized joint or fracture are best prevented by "nutritional exercise".

When a muscle passing over a joint contracts, two things occur: (i) all the structures of the joint,

and not only the muscle, receive a flushing of fresh blood; (ii) all the fibrous tissues of the muscle and attached fasciæ and connected joint ligaments are moved through a definite range, small, but enough to maintain blood supply and elasticity.



FIGURE VIII.

Flexing a stiff extended elbow. 1: turnbuckle for fine voluntary adjustment of 2, the spring, the latter allowing exercise. The splint can be removed or reapplied in three minutes.

So-called adhesions, which later prevent movement at the joint, are in the great majority peri-articular fibrous bands, and are minimized by nutritional exercise. Wasting of bone, decalcification or osteoporosis is mainly due to lack of the physiological blood supply and nerve stimulus, and is again minimized by nutritional exercise.



FIGURE IX.

Practitioner's first aid for any upper limb fracture. Applied in three minutes, all joints held immobile, limb elevated, whole splint radio-translucent, except for wingnuts.

The seventh ideal, then, in treatment is automatically attained by the active movements of shoulder, wrist and fingers, in the provision from the outset for contraction of the muscles passing over the joint, while immobility of the fragments is maintained.

#### Early Active Movement (Principle Number VIII).

Having discussed the principles underlying anatomical reduction and retention, the position of the set limb and the provision of exercise of some sort for every joint, we are led naturally to the last, the eighth principle—restoration at the earliest possible moment of active function. Here we must consider the place of massage, passive movement, hot air and diathermy. I imagine that all of these will always have their place. But I believe that all are becoming progressively less necessary, with improvements in technique and equipment, and in treatment during immobilization. The aim is to prevent, rather than to treat, so-called adhesions, muscle shortening, fibrosis and wasting, atrophy of bone and ligament and ultimate arthritis.

Heat, properly applied, and intelligent massage, can never do harm, and they give comfort and benefit. Of passive movement I am very suspicious.

My own rule, if passive movement seems indicated, is never to do it without the active cooperation of the patient, and never until all local reaction has ceased, when manipulation may come into its own. For example, in flexing the elbow, secure a good voluntary contraction of the biceps and then, while palpating the biceps, aid the movement, but cease immediately the biceps relaxes. In this way the triceps is prevented from reflexly contracting from pain and so conducting a struggle against the flexion effort of the surgeon, with the partly healed elbow as a fulcrum.

Assisted purposeful movement can be undertaken with safety much earlier than purely passive movement, because Nature gives her own warning.

#### Principles of Early Active Movement.

1. Early active movement should be undertaken only when the bones have so united that displacement or bending is unlikely and inflammatory reaction in the soft parts has so subsided that residual pain is minimal. By this I mean that pain, although possibly present during the movement, should not continue to any appreciable extent after movement has ceased.

2. First efforts should be tentative and should be guided and aided by the surgeon.

3. They should be minimal; therefore the force of gravity should be eliminated.

4. The retention apparatus should be at once replaced, if in the surgeon's opinion the effort is made too early. It is better still if the movements can be carried out without removal of the limb from the splint. I have had made a splint for the lower limb, and the abduction splint for the upper limb, which allow this. It has the advantage that if the hyperflexed position is desirable in treatment, it can be so used while the horizontal is maintained for the whole limb.

#### The Treatment of Stiff Wrist, Stiff Fingers and Volkmann's Contracture.

Stiffness of wrist and fingers and Volkmann's contracture are unfortunately still very common

as an aftermath of elbow joint fractures. Stiffness is naturally much commoner in the more severe injuries sustained by the less vital joints of adults in occupational accidents. They are mainly due to two things:

- I. Circulatory embarrassment due to: (a) the dependent elbow, (b) excessive flexion, (c) pad pressure at the flexure, (d) tight bandage, (e) neglect to split a plaster on complaint of pain.

- II. Neglect of active movements of all finger joints, wrist and shoulder from the outset.

Their treatment is one of the major problems of occupational injuries and can be only glanced at, there being no space to give reasons. In my opinion again, passive movement, hot air, massage and diathermy are playing an increasingly small part and are being replaced by two principles:

- I. Purposeful coordinated movements—reeducation in its many clever guises, and actual occupational use.

- II. Until the fingers and wrist are sufficiently mobile to use the foregoing, constant gentle elastic traction throughout the twenty-four hours, varied for an hour twice a day by active movement through the range of movement obtained. I have designed a splint (Figure VII) to allow of this being done. Simultaneous treatment can be applied to any or all of the fingers, thumb and wrist in various positions.

- III. In the application of this principle of continuous elastic traction a third principle may be considered, namely, that results are more easily obtained by traction at the end of a lever than near its fulcrum. Although the many forms of treatment suggested for Volkmann's contracture testify to their inadequacy, this principle would suggest that it is best, at first, to disregard the pronation and flexion at the wrist, actually to flex the metacarpophalangeal joints and to concentrate on straightening first the distal and then the proximal finger joints. In itself this allows some extension of the wrist, which is then continued, *pari passu*, with the continued finger extension. This allows a grip, after which occupational and reeducational therapy deal most efficiently with the pronation.

Volkmann's contracture occurs mainly in children; but other types of contracture and rigidity are tragically common in occupational fractures, and the same general principles apply.

#### Summary of Ideals and Principles.

1. Complete examination of the limb, including all joints, nerves and tendon grooves, especially the bicipital.

2. Anatomically correct reduction and retention.

3. The use of a form of retention allowing for the mid-position of as many joints as possible, consistent with complications and difficulties in retention.

4. The maintenance of a position of greatest circulatory ease.



5. The investigation of all complaints of pain requiring more than a simple sedative for sleep.

6. Relaxation of the dominant muscles attached to short fragments.

7. Nutritional exercise of the immobilized part, automatically attained by early active movement of every joint of the limb not included in the immobilized area.

8. The choice of time and method for active movement of the immobilized part to be guided by certain general considerations discussed.

9. The treatment of adhesions and contractures in the main by voluntary effort and continuous traction, the surgeon's aid being supplementary (Figure VIII).

#### PRINCIPLES IN COMPOUND FRACTURES AND DISLOCATIONS.

##### The Prevention of Sepsis (Ideal Number I).

The elimination of bacteria is impossible; therefore the elimination of actual sepsis must be attained by the means described below.

*A. The Elimination of Culture Media:* Culture media are mainly of two kinds: (i) dead, dying, or grossly contaminated tissues; (ii) collections of non-circulating blood, clot or serum. These are usually due to: (a) imperfect removal of blood clot; (b) imperfect hæmostasis; (c) imperfect reduction, allowing space between bone fragments or muscles for their re-collection; (d) collections around foreign bodies such as sutures or metal; (e) repeated attempts at reduction after primary closure with inefficient apparatus.

*B. Early Operation:* Early operation insures the elimination of these culture media before bacterial growth has progressed beyond them. The operation should be regarded as urgent and certainly should be undertaken before six or eight hours have elapsed. Later than this, elimination usually fails to prevent sepsis. But even then the minimization of sepsis is aided by accurate reduction and retention (for reasons discussed above), and they become, if anything, more important.

*C. Maximum Circulation:* Elevation of the limb and especially avoidance of compression of vessels by over-flexion or tight bandaging are measures employed in the maintenance of maximum circulation (Figure IX).

*D. Prevention of Further Infection:* For the prevention of further infection it is vital to obtain early clean union of skin over the whole of the injured tissues. This may be attained by the following:

I. Care not to wash or shave infection into the wound from the surrounding skin, both washing and shaving being avoided or reduced to a minimum. The surgeon does all the cleansing on the operating table. As an antiseptic I have found "Dettol" satisfactory, but am careful to leave no residue of it on or in the wound.

II. *Débridement* of traumatized skin edges. A very sharp knife is needed; grasping of skin, other than the thin ribbon to be removed, is avoided.

IV. Closure without tension. There are four important factors here: (a) nursing before operation in the position of circulatory ease, to avoid œdema (this should be more emphasized to first-aid workers, nurses and resident medical officers; for it can be attained only by their intelligent cooperation and is a potent argument for special fracture clinics); (b) if necessary, removal of œdema by the surgeon manually; (c) removal of a minimal strip of lacerated skin; (d) if necessary, a plastic operation.

The necessary skin is usually best obtained by sliding round the limb a flap from adjacent areas after undermining. Incisions should be in the length of the limb and 5.0 to 7.5 centimetres (two to three inches) away from the wound edge, to insure good nourishment for the flap. In extensive cases it may be necessary to make a longitudinal incision on the opposite surface of the limb and slide the whole undermined skin of the limb round in two halves to meet over the wound. If this is impossible, it may be obtained by a pedicle flap from the flank or abdomen; but this necessarily interferes with subsequent reduction and retention and exercise. The surgeon will then consider the relative dangers from deformity and from sepsis, and may prefer to rely on accurate apposition of deep fascia rather than of skin, with non-irritating antiseptic dressings.

*E. Avoidance of Repeated Attempts at Reduction:* If possible, the surgeon should have available at the time of operation the most efficient means of reduction and not rely solely on manual manipulation.

##### Treatment as a Closed Fracture (Ideal Number II).

It has already been emphasized how perfect reduction and retention and nursing in the position of circulatory ease aid the elimination of sepsis. It is, then, in compound fractures especially that no compromise with these ideals can be made. As they more commonly occur in industrial accidents in adults, all the resources of wire and stirrup traction in a traction frame for reduction, spring or weight traction for retention, an efficient and adjustable abduction frame, or nursing in bed with suspension for circulatory ease, may be needed.

##### The Removal of Loose Fragments.

The following are the main considerations in regard to the removal of loose fragments of bone:

I. There is almost no portion of bone involving the elbow joint which can be spared without serious impairment of function. Even loss of the radial head in adults always results in some limitation of movement, more or less disabling; while in children, loss of the epiphyseal cartilage causes *cubitus valgus*, often with marked radial deviation of the hand.

II. Loose fragments in themselves do not appear seriously to increase the risk of sepsis. It is their imperfect reposition, resulting in a pool of clot

and stale serum, which provides the culture medium that leads to sepsis.

III. With full wire or pin and stirrup traction in a traction frame, and operation while still in the traction frame, loose fragments can be manipulated into position and retained there until the skin wound is closed. The chief bar to retention by plaster cast is found to be œdema, which should be minimized by pre-operative nursing and pressure massage during operation. It may be found possible to apply a plaster cast while the limb is still in the traction frame, traction being subsequently maintained either through the pin or the cast, as may be deemed advisable.

IV. Such wound repair, reduction, retention and limb elevation will usually result in first-intention healing, if done within six or eight hours.

V. If these procedures are carried out later than eight hours after the injury the wound can be considered to be already septic and will almost certainly suppurate, and loose fragments of bone are doomed. Even then, unless they interfere with drainage, delay in their removal does not aggravate the condition and may aid the retention in position of the remainder.

VI. Apart from loose bone which lies within a joint cavity, fragments, unless interfering with drainage, can always be removed at a later stage without further detriment.

The deductions that may be drawn from the foregoing considerations are as follows:

(i) Provided accurate reduction and retention can be secured within six to eight hours, there is almost no justification for the removal of any significant mass of loose bone.

(ii) When facilities are unobtainable for accurate reduction and retention, loose bone should be removed only when it is a bar to such reduction or retention, or when it favours sepsis or prevents drainage. It should be remembered that, should primary union of the wound occur with bones in bad position, reduction can again safely be attempted at the end of ten days. This interval allows time for the transport of either patient or apparatus.

(iii) An exception to this rule is in adults, when the radial head is not only displaced, but comminuted. There is no risk of shortening and valgus from epiphyseal involvement, the head cannot be replaced within the orbicular ligament to maintain its relations or to prevent its ossification in bad position, and early movement becomes more essential with increasing age. In children every effort should be made to restore and replace the head in position, in the hope of saving at least the growing portion of cartilage.

#### Drainage.

The rules regarding drainage are not affected by the special problems of the elbow joint. As in all compound fractures, a drainage tube *per se* greatly increases the risk of sepsis.

Where there is great loss of substance, especially of bone, a collection of blood and serum will occur, which must be drained. The tube, however, should be brought out through a stab wound and not through the line of suture. Sometimes such loss of substance can not be avoided and may have occurred directly from the accident, before operation. Apart from that contingency, however, I think it much less risky to replace all bone and so abolish free serum, after accurate reduction, than to rely on a drainage tube. In addition, it gives the patient at least a chance of a good joint.

#### Results of Resection.

Even in the worst compound fractures I am encouraged to endeavour to retain every portion of bone. I do this even at the risk of severe sepsis, and go through the full routine of endeavouring to obtain a closed wound with primary union, by the knowledge that the results of failure are not so ghastly here as in other joints. There remains, after thorough healing and disappearance of œdema from the part, the alternative of resection.

In this operation the joint ends of all three bones are widely removed. Indeed, success here, in distinction to other joint operations, depends upon the wide removal of bone. There should be three fingers' breadth between the arm and forearm bones in the extended position when placed on a moderate stretch. At operation a flail joint looks to be inevitable when so much bone is removed.

I have not had experience with less removal of bone; but the wide experience at Liverpool under Sir Robert Jones was distinctly unfavourable.

CASE I.—The patient is a girl who had a painful ankylosis of the elbow. She started with a fracture of the radial head, for which treatment was not sought for some time. I saw her first when she had about 60° of movement and much pain. I was then unaware of the value of anatomical immobilization with nutritional exercise. Alternating periods of splinting and of passive movement, hot air, massage, diathermy, and manipulation under anaesthesia (in pursuing which I was fortified by the concurrence of the best orthopaedic opinion I could get), resulted in complete loss of movement and over-pronation. Several minor operations on *fasciæ et cetera* in an endeavour to restore supination failed. Finally I resected the joint by the technique indicated. In spite of a post-operative suppuration some two months later, she has a strong, useful elbow. Supination has been restored recently, after two years of active, painless use.

#### Summary of Principles in Compound Fractures.

1. Early operation, before six hours have elapsed.
2. Antisepsis and avoidance of further contamination by a complicated skin preparation.
3. The least irritating antiseptic consistent with efficiency.
4. Minimal *débridement* of all tissues consistent with efficiency.
5. Maximum conservation of bone.
6. Complete covering of injured tissues by skin, with the avoidance of tension.
7. Avoidance of drainage tubes, except to actual cavities.



8. Quick, efficient reduction and retention by the best means available.

9. Neither exercise nor disturbance of the wound until either apyrexia is well established or gross sepsis is certain. Pain and lymphadenitis may be better indicators of sepsis than either tension or pyrexia.

10. Subsequent treatment of the limb according to the principles for a closed fracture, and of the wound by established surgical methods.

### Reports of Cases.

#### CHRONIC INTUSSUSCEPTION REDUCED BY RECTAL INJECTION AFTER FOUR MONTHS.

By DOUGLAS ANDERSON,  
*Sydney.*

A MALE infant, aged seven months, came under my care on August 1, 1936, on account of failure to thrive. It weighed 3.96 kilograms (eight pounds thirteen ounces) and it had weighed 4.41 kilograms (nine pounds thirteen ounces) on July 15. At birth it had weighed 3.15 kilograms (seven pounds) and about 4.5 kilograms (ten pounds) at three months, but never much more. Its condition was said to be deteriorating rapidly. Its diet was cow's milk diluted with water, and it resisted its four-hourly feeds, so that they were not always taken in full. It had had a distressing paroxysmal cough ever since having measles at the age of four months. It had always had a tendency to diarrhoea, and the stools had always been greenish; but for the last week it had had seven or eight small motions a day, always very pale. It had vomited twice on July 30. A colleague had felt a mass in the region of the spleen on July 15.

The child was emaciated to a degree and looked rather ill, but it still "had a kick in it" when its abdomen was examined. I could feel nothing abnormal, but a large subcutaneous injection of saline solution had just been given into the abdominal wall; the abdomen was somewhat swollen with wind. Nothing abnormal was palpable through the rectum. A stool was small and white, with greenish flecks, and there were many large blobs of mucus. There were a few fine adventitious sounds to be heard in the chest, and cough was frequent and moist.

Hourly spoon feedings with a good prepared food were instituted and the baby gained 56.6 grammes (two ounces) in weight in two days. But the child squealed a lot and slept badly. The bowels acted frequently, but the stools were smaller, though unchanged in character.

On August 3, reexamining, I at once felt a mass, firm and mobile, apparently tender, within the abdomen near the left antero-superior spine. Its degree of firmness varied noticeably during the examination. It was an intussusception.

A rectal injection of saline solution was given according to Dr. Hipsley's directions in THE MEDICAL JOURNAL OF AUSTRALIA of August 14, 1926. The mass was then found to have disappeared and the infant slept. It was not possible to be sure that the intussusception was quite reduced, for there was now a mass, much smaller, but still palpable, deep in the right iliac fossa; but I did not care to advise laparotomy.

The mother was questioned about blood in the stools. She said that when three months old the baby had seemed in pain one day and she had found bright red blood on two of its napkins. She obtained a bottle of medicine for it and it passed no more blood, though it seemed very ill for several days.

From August 3 the diarrhoea ceased; the infant took its food normally and slept peacefully. On August 17 it weighed 4.5 kilograms (ten pounds), and on September 20, 5.48 kilograms (twelve pounds three ounces).

### Reviews.

#### PAGET'S DISEASE OF THE NIPPLE.

PROFESSOR KEITH INGLIS's monograph<sup>1</sup> is a carefully written and well illustrated summary of our knowledge of Paget's disease of the breast and of various precancerous states of the skin and other squamous stratified epithelial surfaces. Although many of these lesions have little in common with Paget's disease, the author has succeeded in presenting his material in a logical and well balanced manner, so that perusal of his book gives an excellent idea of the relationship to one another of diverse cancerous and precancerous lesions of the skin and allied epithelia. The author supports the view of Sir Robert Muir and others, that Paget's disease is essentially invasion of the epidermis by carcinoma cells spreading from primary neoplastic foci near the mouths of the lactiferous ducts, and that the Paget cells are tumour cells.

The chief merit of this work is to be found in the many excellent illustrations, 237 in number, most of them photomicrographs. These are of a uniformly high standard and have been well chosen to illustrate and supplement the descriptions in the text. They are so arranged that low power and high power photomicrographs of a section appear on the same page; this is a distinct advantage. The volume forms indeed an admirable descriptive atlas of this section of tumour pathology.

In a work like this, dealing with a relatively restricted subject, it is a little disappointing not to find a critical review of literature. The author refers to only 67 previous papers and books, mostly English and American, and it is to be regretted that, with his ample and informative studies, he has not attempted a more comprehensive survey of the large and confusing mass of records in this field. However, this defect does not detract from the value of the author's own carefully recorded observations and personal conclusions. The work will prove a useful source of information to both pathologists and clinicians.

Like all Oxford medical publications, the book is beautifully produced, the reproduction of the photographs being particularly excellent. For a book of only 224 pages of rather large print, however, the price is, we think, rather high; there is something wrong when Australians have to pay fifty-four shillings for a book that sells in England for thirty-six shillings.

#### BACTERIOLOGY FOR STUDENTS AND PRACTITIONERS.

IN recent years the science of bacteriology has undergone greater changes and greater developments than in any period since its infancy. It is therefore difficult in one single text-book to give details of all the latest developments in this science. "A Handbook of Bacteriology", by Dr. Joseph W. Bigger, now in its fourth edition, is a text-book of bacteriology which, while it does not give the detailed information of these latest developments in bacteriology to be found in larger and more comprehensive text-books on the subject, serves a very useful purpose.<sup>2</sup> It is written primarily for students and medical practitioners, and gives in simple terms the general principles of bacteriology.

Chapters I to VII, inclusive, comprising 102 pages, are devoted to technique. Chapter II details the use of the microscope and the technique of staining bacteria. The formulae of the commonly used stains are given. Chapter III is devoted to sterilization and describes concisely the

<sup>1</sup> "Paget's Disease of the Nipple and its Relation to Surface Cancers and the Precancerous States in General", by K. Inglis, M.D., Ch.M.: 1936. London: Oxford University Press (Humphrey Milford); Australia: Angus and Robertson Limited. Double crown 8vo, pp. 245, with illustrations. Price: 54s. net.

<sup>2</sup> "A Handbook of Bacteriology for Students and Practitioners of Medicine", by J. W. Bigger, M.D., Sc.D., F.R.C.P.I., D.P.H., M.R.I.A.: Fourth Edition; 1935. London: Baillière, Tindall and Cox. Demy 8vo, pp. 474, with illustrations. Price: 13s. 6d. net.

various methods. Chapter IV deals with the preparation of media and gives the formulae of all those commonly used. The determination of pH is also dealt with here. Chapter V deals with the technique of making bacterial cultures. Chapter VI describes special technical methods, such as filtration, animal inoculation and vaccine preparation. Chapter VII deals with serological technique—agglutination tests, determination of opsonic index, the Wassermann reaction and the Kahn reaction.

Chapter VIII deals with the collection of material from the patient for bacteriological examination. This is an important chapter in any text-book of bacteriology, as many specimens are ruined through inept collection. The chapter is unfortunately rather brief.

Chapter IX describes methods for the identification of pathogenic bacteria and the appearances of growth on special media and special biochemical reactions.

Chapter X deals with the bacteriology of water, milk and shell-fish. While this is of interest, the subject is dealt with very superficially and would be totally inadequate for those contemplating a course in public health.

Chapter XI deals briefly with antiseptics and disinfectants.

Chapters XII to XLVI, the final chapter, are devoted to the detailed study of pathogenic bacteria.

Chapters XIII, XIV, XV, XVI, XVII, XVIII and XIX are devoted to the subject of immunity. They are quite readable and give the fundamentals of this branch of the subject. There is no attempt at wide discussion, and the information given is suitable only for those seeking general knowledge.

Chapter XX gives a detailed classification of bacteria, and the remaining twenty-six chapters are devoted to a more detailed study of each organism. In these chapters the principal parts relating to the various bacteria are given, but much new work is not mentioned. For example, in the chapter on the pneumococcus, no mention is made of the thirty-two different types now recognized, and the Neufeld "Quelling" reaction for rapid determination of type is not discussed. In the chapter on tetanus no mention is made of recent advances in treatment. The final three chapters are devoted to viruses, pathogenic protozoa and pathogenic fungi.

There are numerous illustrations and there is no bibliography.

#### A TEXT-BOOK OF PATHOLOGY.

SIR ROBERT MUIR'S "Text-Book of Pathology" has now entered its fourth edition,<sup>1</sup> and it is significant that, while five years elapsed between the first and second editions, and four years between the second and third, only three years have passed since the third edition was reviewed in these pages. It was remarked then that anyone interested in clinical problems could pick up this book and read it with interest; the same is true of the present edition. Further, the author has contrived to keep his book at once simple and comprehensive, so that it is suitable for students of all grades.

In the previous edition the size of the book had been increased, but the present edition contains only the same number of pages as its predecessor. This is a welcome feature, even though it has necessitated a fair amount of condensation, but any compression that has been employed does not detract from the easy and lucid style of the book. Here and there the inquiring critic can find minor details lacking, or scant references to obscure, rare or unimportant conditions, but this is no disadvantage in a text-book whose major virtue is its balance. It is difficult to single out instances for mention in a book so wide in scope and so compact in treatment, but it will be found that it is up to date and that it conveys all essential information on modern pathology that will be required by the student or clinician.

<sup>1</sup>"Text-Book of Pathology", by R. Muir, M.A., M.D., Sc.D., LL.D., F.R.S.; Fourth Edition; 1936. London: Edward Arnold and Company. Demy 8vo, pp. 1001, with illustrations. Price: 35s. net.

Muir still keeps an open mind on controversial problems and does not hesitate to express doubt on the one hand or, on the other, to indicate where he has changed his mind. This fourth edition may be cordially recommended as a sane and clear guide to the study of pathology, for it is doubtful if there is any other book of like size which contains the same authoritative presentation of the subject.

#### EMERGENCY SURGERY.

FIVE years ago we reviewed the first edition of Mr. Hamilton Bailey's "Emergency Surgery", in two volumes. The second edition is now to hand, and the original two volumes have been incorporated in one which is of reasonable size; this alone is an improvement.<sup>1</sup> The publishers, John Wright and Sons, have maintained their usual high standard. About the first edition we wrote: "On the whole the book fulfils its purpose admirably, although we must disagree with some of it." This criticism applies to some extent to this new edition; for example, the subject of "post-operative pneumonia" is still inadequately described. In the prevention of hæmorrhage after prostatectomy we missed any mention of Harris's operative technique, which must now be accepted as one of the best prophylactic measures at our disposal. On the drainage of acute empyema we find this statement: "It is not usually advisable to remove the tube for a week." Such advice makes for chronic empyema; one cannot too strongly emphasize that the only time to remove the tube is when the empyema cavity has been obliterated by expansion of the lung.

These small blemishes do not seriously detract from the value of this excellent book, which is interesting and instructive throughout. The illustrations are especially worthy of praise.

#### A MEDICAL CURIOSITY.

"THE COMMON COLD AND INFLUENZA", by J. E. R. McDonagh, is an amazing book full of extravagant statements and inaccuracies.<sup>2</sup> It incorporates the Nature of Disease Annual Reports for 1934 and 1935. The frontispiece is a masterpiece. It is a diagram showing the mutation forms of the *Bacillus coli communis* arranged in six ladders. Apparently this very common organism has assumed remarkable properties of transformation and, according to this diagram, by ascending or descending the various ladders can change at will into any form of bacterium or virus. The book opens with a prologue. Then follows the clinical section, in which the most amazing statements are made. One of these reads: "Psittacosis is only a form of influenza, and it is not a specific infection, as it may be caused by the filtrable sub-phases of the *Streptococcus faecalis* as well as by those of the *Bacillus faecalis alkaligenes*." On page 47 it is stated that Friedländer's bacillus is responsible for lobar pneumonia and cerebral influenza and that a study of the blood pictures explains why the hydrated protein particles undergo precipitation in the lungs and in the brain. Surely this is heresy.

Then follows the bacteriological section. This opens so: "The Common Cold and influenza are different forms of the same acute manifestations of disease. The manifestation arises through the activity of the pathogenic mutation forms of the *Bacillus Coli Communis* in the large intestine." The rest of the book is written in a similar strain and closes with the epilogue. We feel that the main value of the work is that it constitutes a medical curiosity.

<sup>1</sup>"Emergency Surgery", by Hamilton Bailey, F.R.C.S.; Second Edition; 1936. Bristol: John Wright and Sons Limited; London: Simpkin Marshall Limited. Medium 8vo, pp. 852, with 812 illustrations, of which a large number are in colour. Price: 50s. net.

<sup>2</sup>"The Common Cold and Influenza and Their Relationship to Other Infections in Man and Animals: The Nature of Disease Annual Reports for the Years 1934 and 1935", by J. E. R. McDonagh, F.R.C.S.; 1935. London: William Heinemann (Medical Books) Limited. Imperial 8vo, pp. 158. Price: 12s. 6d. net.

## The Medical Journal of Australia

SATURDAY, DECEMBER 26, 1936.

All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

References to articles and books should be carefully checked. In a reference the following information should be given without abbreviation: Initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year); number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.

Authors who are not accustomed to preparing drawings or photographic prints for reproduction, are invited to seek the advice of the Editor.

### THORACIC SURGERY.

FERDINAND SAUERBRUCH, Professor of Surgery in the University of Berlin, in an address delivered in England in November, 1935,<sup>1</sup> said almost at the outset that thoracic surgery had become a standard branch of medical science. In Australia, owing partly no doubt to the great distances which separate us from renowned medical centres in the old and new worlds, and partly to our relatively small population, the medical profession is slow to recognize the division of surgery into branches or specialties. But this division is bound to come; and of course it will come first in the large centres of population and more gradually in other places. Urology, orthopaedic surgery, cranial surgery and thoracic surgery are becoming so involved and demand such study and concentration that devotion to any one of them will exclude almost any other surgical activity. Of all these branches thoracic surgery is probably the least advanced, and for this reason attention should be drawn to Sauerbruch's address.

The growth of thoracic surgery is a fascinating story. Sauerbruch states that its development during the last three decades has been systematic; those who have been in practice for that period and who have followed the progress of surgery will agree in this statement. To adopt in the thorax the surgical procedures that were followed with impunity in the peritoneal cavity was soon found to be impossible. Empyema, for example, could not be treated like an abscess—the number of deaths following the opening and draining of the pleural sac was in certain cases appalling. Surgeons began to realize that patients died not because of the seriousness of operative intervention, but because the empyema was due to a certain type of infection, or because opening the thorax had certain effects on the heart and lungs. Sauerbruch points out that even the type and the quantity of the exudations in the pleural sac are different from those of the abdominal cavity. The peritoneal cavity responds to mechanical and inflammatory injuries mostly with fibrinous exudates, which lay the foundation for the early capsulation of the focus of the disease. The pleura, on the other hand, is prone to serous exudation, which hampers treatment after intrathoracic operations. Further, in spite of technical success, the liability of these serous effusions to secondary infections often leads to disastrous results. Sauerbruch shows that among the researches that have helped to awaken interest in thoracic surgery are: investigations into the lymphatics of the pleura, lungs, diaphragm and mediastinum; the discovery of the influence of distension and retraction of the lung on the distribution and stream of the blood in the heart and lungs; the finding that, as a result of the movement of the organs, especially the heart, blood coagulates much more easily in the thoracic cavity than in other parts of the body; and the discovery of the enormous powers of adaptation and substitution possessed by the lungs. Curiously, he does little more than mention modern anaesthesia and its importance in operations on the thorax. It deserves much more than passing notice, for without it we should not have arrived at such a stage that even thoracotomy is sometimes justifiable as a diagnostic procedure.

<sup>1</sup> *The Lancet*, September 26 and October 3, 1936.



The various conditions in which intrathoracic operation may be undertaken and the different procedures adopted are probably well known to readers of this journal. In pulmonary tuberculosis alone the procedures are many. While it may be true that surgery is not used as frequently in pulmonary tuberculosis as it should be, it must be remembered that the indications for interference must be clear and that the operator must be experienced in intrathoracic manipulations. Sauerbruch refers to results claimed for thoracoplasty by six workers in 1,160 cases; in these it was claimed that 42.3% of the patients had actively followed their work for a year without any signs of the disease. In his own clinic he had records of over one thousand cases; when the patients were carefully selected the percentage of cures was 70 to 80; when selection was not so carefully made the percentage was only 40.6. It is necessary only to mention surgery of abscess of the lung, of bronchiectasis, of cancer of the lung, of the mediastinum and of the œsophagus, to show how enormous is the field that has to be covered. Sporadic reports of successful thoracic surgery have appeared in this journal from time to time; probably we should be justified in stating that at present surgery of the thorax is in its infancy in Australia. In due course no doubt we shall hear of the formation in some of the larger centres of special clinics where workers will be trained to acquire the technical skill necessary for thoracic surgery. This will be a distinct advance. While aiming at this state of affairs, we should remember the words of Sauerbruch when he states that technical skill should never degenerate into an end in itself. "There should be a living contact with the whole science of medicine, and, before all, with the great science of surgery."

### Current Comment.

#### ANOREXIA NERVOSA.

ANOREXIA NERVOSA was named and described in 1868 by Sir William Gull, and in this, as in other matters, his writings have withstood the challenge of nearly seventy years. It was a peculiar disease, he said, affecting young females between the ages of sixteen and twenty-three years. The sufferers

one and all refused food, so that the chief mark of the malady was emaciation, so extreme that life hung on a thread. Yet the prognosis was often favourable, since the disease bore no relationship to tuberculosis; while life continued there was hope. Give the patient food, overcome the morbid mental state which made her loathe and refuse it, and a cure would follow.

Professor John A. Ryle,<sup>1</sup> in the Schornstein Lecture of the year, discusses his experience of the disease since the end of the War. His remarks are based upon the observation of fifty-one cases seen in private and of a further six in hospital practice. The discrepancy in numbers seems strange at first sight, but there is a simple explanation of it. *Anorexia nervosa*, not alone in psychoneurotic disorders, is an affection of the upper and middle classes, whose members, when ill, are often accorded misplaced sympathy and have leisure to enjoy the solicitude of relatives and their own self-pity.

Of Ryle's fifty-one cases, five occurred in males and forty-six in females. Thirty-three of these women were below thirty years of age, and all but one unmarried. The remaining women ranged in age between the years of thirty-one and fifty-nine, and all but five were married. This fact—the occurrence of the disease in women, of whom some at least were past the menopause—seems to disprove the contention that ovarian imbalance or dysfunction is the essential cause of the condition as observed in younger patients. The predisposing or exciting causes are in reality many, but all have an emotional basis. Quite commonly a taint of unstable nervous heredity is discoverable, though tact and delicacy are often needed to unearth it. Then there are the storms which rage round love affairs, broken betrothals, coldly received avowals of devotion to teachers or to fellow pupils. Sometimes a course of "slimming" induces the anorexia; sometimes it is the result of overwork or unhappiness at school, or of coddling by indulgent parents. But in all cases an important factor is the patient's desire that somebody should yearn and weep over her. She imagines herself standing in the middle of the stage, clad in a suitable robe and bathed in a light of appropriate softness, to the sound of muted violins. All this, at bottom, is in the bulk of instances an example of natural phenomena turned morbid, of heavy accents laid upon the normal uncertainties, blushings and panics of early womanhood.

The disease begins, as its name indicates, with loss of appetite and the patient toys with her food. No dainties tempt her and soon the very sight of a plate is repulsive. One of the earliest signs of the disorder is amenorrhœa; it precedes the inevitable signs of emaciation seen in the developed condition. The stoppage of the menses may be regarded as resulting from the initial nervous damage and psychic upset which set the disease in motion. It is the first token of the condition to appear and the last to go; and the recommencement of the monthly flow is certain evidence of cure.

<sup>1</sup> *The Lancet*, October 17, 1936.

The course of *anorexia nervosa* may be measured in terms of months or years. Some patients remain difficult of treatment throughout their lives; others die of starvation and, in the uncomplicated cases, of nothing else. The typical sufferer is a young woman, between the ages of fifteen and twenty-nine years, of emaciated appearance and with the air of one who has barely escaped death in a famine. There is a history of amenorrhœa, of loss of appetite, at first partial and later complete, of great loss in weight, amounting at times to as much as four stone, and of frequent emotional upsets. There is neither cough nor fever, no anæmia, no evidence pointing to the presence of tuberculosis, diabetes, hyperthyroidism or malignant disease, the common causes of such an alarming loss in condition. Physical examination reveals no sign of these serious organic diseases, even when the X rays are employed as a routine, as they should be. A growth of down is commonly found on the body surfaces, and sometimes a beard of some size sprouts from the chin. The blood pressure and pulse frequency are both below normal.

The prognosis, given early diagnosis and treatment, is good. Cooperation with the doctor is an important feature in securing an early recovery, and institutional treatment is sometimes essential if the harm done by over-anxious relatives is to be avoided. Complications caused by deficiency diseases are strangely few; in Ryle's group of patients none contracted scurvy, beri-beri or even the œdema produced by starvation. To be successfully treated, the patient must be convinced by tact and firmness that a sufficiency of nourishing food will cure her. The diet should be mixed and sloppy invalid foods abandoned. The régime should be commenced while the patient is in bed and safe from the ministrations of over-sympathetic and incompetent relatives. Psychoanalytic treatment is usually harmful, and there is no need to employ, as some have enjoined us to employ, either thyroid extract as a weapon against the lowered blood pressure and subnormal temperature, or insulin to assist the carbohydrate metabolism.

This disease is a striking instance of the manner in which the interplay of mental and physical processes may end in starvation and occasionally in death. The disease is not common, nor is it excessively rare; it must be remembered as a probable cause in all cases of grave bodily wasting.

It is perhaps not impertinent to recall the words of Hobbes, one of England's greatest prose-writers, and her finest philosopher, on the subject of a girl who suffered from *anorexia nervosa*. His letter, here quoted, is an example of his keen and sarcastic humour:

Part of her belly touches her backbone. She began . . . to lose her appetite in December last and had quite lost it in March following: insomuch as that for the last six months she has not eaten or drunk anything at all, but only wets her lips with a feather dipt in water. Some . . . that see her for curiosity, give her money, which she refuseth, but her mother taketh . . . The woman is manifestly sick and 'tis thought she cannot last much longer. Her talk is most heavenly. To know the cer-

tainty, there be many things necessary which cannot honestly be pryed into by a man. Whether any excrement pass, or none at all. For if it pass, though in small quantity, yet it argues food proportionable, which may, being little, be given her secretly. Whether no urine at all pass; for liquors also nourish as they go. I think it were somewhat inhumane to examine these things too nearly, when it so little concerneth the commonwealth . . . I cannot therefore deliver any judgment in the case. The examining whether such a thing as this be a miracle belongs I think to the Church.

This letter was written in 1668, and its tone strongly suggests the writer's suspicion of fraud. The modern medical man, however, is more concerned with a curious clinical entity which, by reason of its relative rarity and its superficial likeness to other serious diseases, may easily be overlooked.

#### AMIDOPYRIN AND BLOOD CELLS.

MEDICAL literature is well stocked with reports of agranulocytosis that has followed the ingestion of amidopyrin; and the conclusion is justified that the blood condition has been caused by the drug. W. B. Rawls states that there has been no analysis of the effect of amidopyrin on the blood cells of a large number of patients.<sup>1</sup> He has undertaken an analysis of this kind. He has sought to determine the frequency of the occurrence of agranulocytosis in a series of patients treated with amidopyrin and also to discover any change in the red and white cell counts, or in the polymorphonuclear cell count, of patients who were treated with amidopyrin but who did not suffer from agranulocytosis. In some cases "Magnepyrin", a preparation containing amidopyrin and magnesium carbonate, was used and sometimes the amidopyrin was given alone. The patients received on an average a daily dose of 13.08 grains and a total of 1,098 grains during an average period of 84.36 days. During three years over 100,000 tablets containing amidopyrin were administered to 400 patients. Four of these became affected by agranulocytosis and three died. In five patients the white cell count was reduced from about 5,000 cells per cubic millimetre to 3,000. On the other hand, occasionally the polymorphonuclear cells increased from 50% to 55% and the number of white cells was increased. The results of the treatment of 100 patients were subjected to statistical analysis. The only change noted was a significant increase in the red blood cells. This was most pronounced in rheumatoid arthritis in males. There was also a slight increase in the white cell count in females with rheumatoid arthritis; there was a possible significant decrease in the polymorphonuclear counts in females with miscellaneous arthritis. Rawls concludes that amidopyrin does not produce hæmatological changes except in isolated cases, when there is probably an idiosyncrasy to the drug. It should be noted that the untoward results obtained by Rawls occurred in elderly persons or those with long-standing infections.

<sup>1</sup>The American Journal of the Medical Sciences, August, 1936.



## Special Article.

### THE INTERRELATIONSHIPS OF THE SEX HORMONES.

THE very word hormone now conjures up a sense of bewilderment in the mind of the general practitioner, who, like the infantry in the war, bears the brunt of the daily battle of medical practice, who has little time or opportunity to follow the countless lines of thought which go to form the basis of new plans of campaign, and who finds the specialist field manuals written, in part at least, in some new variety of shorthand.

For the purposes of simplification I shall deal with some striking and significant relationships between the sex hormones, primarily because it is in this field that most rapid progress has been made, and in which the chemistry of the compounds is known; and, secondarily, because of the new significance which research in this field has given to the metabolism of cholesterol, to vitamin D, and to the structure of the carcinogenetic substances in coal tar. These hormones comprise two groups, which may be termed primary and secondary. The primary group contains the gonadotropic hormones of the anterior pituitary, of which there are at least two. Their structure is as yet unknown, but they have a powerful effect upon the gonads, bringing about, on the one hand, ripening of Graafian follicles with all the associated phenomena, and, on the other, the growth of the corpus luteum with its own special sequelae. There are, therefore, two primary sex hormones of fundamental importance in the sex cycle of the female, the follicle ripening and the luteinizing hormones respectively; but their significance is just as great for the male, although both as to their action and their specific nature there is much yet to learn.<sup>1</sup> Thus<sup>(1)</sup> it has recently been demonstrated clinically that the anterior pituitary hormone, prolactin A, has a potent effect upon carbohydrate metabolism and upon circulatory efficiency.

My survey proper begins with the secondary hormones produced as a result of the physiological action of the former group. These hormones, it now appears, are all very closely related in the chemical sense, and differences in action, even in sexually specific actions, are found to be the result of quite simple changes in the chemical configuration of the fundamental molecular structure of the parent substance. Even the term "sexually specific" must be qualified, for it is now well established that some male

and female sex hormones can and do each exist in the gonads of the opposite sex, and, in fact, have definite "extra-territorial" biological significance. Among the facts establishing this knowledge are the discovery of and isolation by Zondek<sup>(2)</sup> of a pure female sex hormone from the urine of the stallion, and the very recent synthesis by David<sup>(3)</sup> of a derivative of this group, namely, androstene-3, 17-diol, which by animal experiment was shown to have ambisexual activity.<sup>(4)</sup> [See the chemical schema, Formula (10).]

The average medical practitioner will recall that among those substances about which in his day the metabolic significance was obscure, cholesterol occupied a prominent place. Intervening years have unravelled the story of the red blood corpuscle, its pigment and its breakdown, and, with this, has been obtained a vast amount of insight into the intermediate metabolism of cholesterol. So it comes about that the array of facts can be placed in ordered

arrangement, and cholesterol is seen to stand as the parent molecule from which these immensely potent derivatives, the secondary sex hormones, are formed within the gonads.

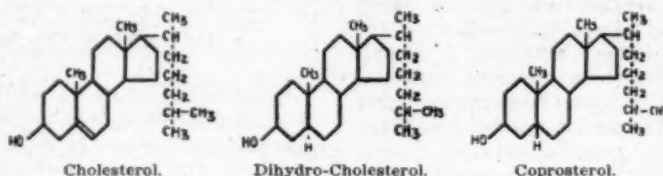
In 1929, both Butenandt<sup>(5)</sup> and Allen and Doisy<sup>(6)</sup> succeeded in isolating a female sex hormone from follicular fluid, and this substance, now known under various names, such as "Theelin", "Folliculin", "Menformon" *et cetera*, was found in 1932 to be a tetracyclic keto-phenol of the empirical formula  $C_{26}H_{42}O_2$ . This fact drew attention to the sterols and bile acids, which were the only other tetracyclic (four-ringed) compounds hitherto known to exist in the animal body, and it was natural to seek for any possible relationship between the newly isolated sex hormone and this family of cholesterol derivatives.

During 1932-1933, Wieland, Windaus, Rosenheim and King finally established the structure of cholesterol,

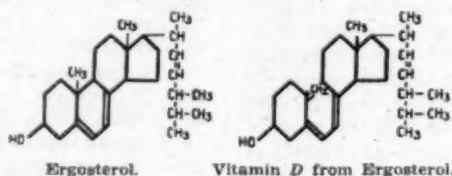
and thus opened the way for chemists to investigate the possibilities of such a relationship. This was finally established through the resurrection of the possible formula from the ashes of chemical degradation reactions, as studied in detail by Doisy,<sup>(7)</sup> Butenandt,<sup>(8)</sup> Marrian<sup>(9)</sup> and Bernal,<sup>(10)</sup> the formula, in fact, being that proposed by Butenandt, and now definitely established as the correct one. [Formula (4).]

Using the resulting enlargement of the comb of the capon as a test for the presence of injected male sex hormone, Butenandt carried the work to another stage in 1931 by isolating from male urine a crystalline hormone which he christened androsterone, and which he recognized as being another tetracyclic compound differing from the female hormone by containing a keto-group, that is,  $=CO$ . Its empirical formula was established as being  $C_{27}H_{48}O$ , and all this information, including that concerning its physiological potency, was established by experiment, only a few milligrammes of material being used. This is, of course, only one of countless similar chemical triumphs resulting from the application of microchemical methods,

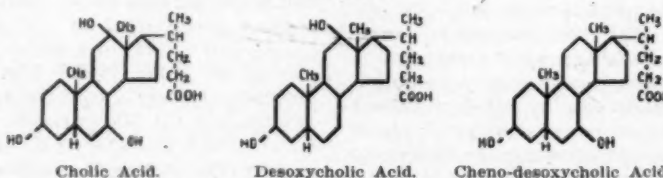
#### CHOLESTEROL GROUP.



#### VITAMIN D GROUP.



#### BILE ACIDS.



Schema showing relation between cholesterol, vitamin D and bile acids.

<sup>1</sup> The bewildering terminology of the trade preparations is due to the fact that the only trade advantage accruing to the discovering firm—if there be a firm—is vested in the trade mark. Every subsequent product from competitors is similarly protected.



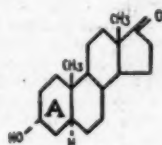
which alone represent one of the greatest technical advances of our time.<sup>10</sup>

If androsterone were related to the sterols, its empirical formula would appear to indicate that it might be a derivative of a hydrogenated sterol of the structure shown in Formula (1). For those who would begin to understand the actions of the sex hormones, it is instructive to follow the reasoning of Butenandt concerning the relation of androsterone to the follicular hormone, that is "Folliculin", "Theelin" *et cetera*. He had isolated from the urine of the pregnant female a compound containing a coprosterol (see figure) ring system. Coprosterol is the form in which cholesterol is passed by the bowel, and is a reduction product due to bacterial action. From this he concluded that androsterone might be an intermediate reduction product between cholesterol and the follicular hormone. Using Butenandt's reasoning, Ruzicka, 1933,<sup>11</sup> attempted to imitate what might be an analogous process of derivation of androsterone in the animal body, and was, moreover, successful, and for the first time a synthetic sex hormone finally saw the light of day. With this success in a difficult field of organic chemistry, the way was opened for extensive study of the relation between structure and physiological action on the part of tetracyclic derivatives of a similar type.

It was found, for example, that the extent of growth of the capon's comb was proportional to the total amount of androsterone administered, and was little influenced by dosage or spacing of doses. Newly hatched chicks, as I have seen, were thus caused to grow mature combs, whilst it soon became evident that stimulation of comb growth by androsterone was not sexually specific. Before proceeding, it is as well to point out that the comb is a secondary sexual character common to both sexes. This non-specificity led to the development of a technique for the purpose of studying sex specific effects, which consisted in examining the effects of the hormone upon the seminal vesicles and prostate of castrated animals. Castration, by removing the effect of the naturally produced hormone, leads to regression in size and in cellular development of these accessory glands; and in work of this type not only increase of weight, but cytological regeneration of these glands, is followed closely during the course of injection.

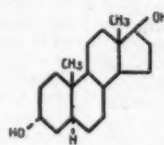
Thus it was found that although injection of "Theelin" caused similar increase in weight of the prostate gland, the cytological changes were abnormal. Androsterone is in this respect quite specific. Small doses restore normal morphology to the atrophied prostate and seminal vesicle; larger amounts are required to prevent regression of weight of the accessory glands in the recently castrated mature animal; whilst still larger quantities are necessary to restore an atrophied prostate or seminal vesicle to its normal weight. Androsterone has a more potent effect upon the prostate than upon the vesicles, and it has been shown at the Lister Institute that this action of androsterone extends to other than sex organs which undergo regressive change following castration. This sex hormone, androsterone, since it was isolated from the urine, has been termed the male urinary sex hormone, and has not been found in testicular extracts, which differ only quantitatively on their effects from those produced by androsterone. Laqueur, and Gallagher and Koch,<sup>12</sup> however, estimated these quantitative differences, and found that androsterone was much less potent, whilst certain chemical differences, especially the possible existence of an unsaturated ketone group in the testicular extract hormone, led Ruzicka to suggest two alternative formulae for the substance. Laqueur in Amsterdam,<sup>13</sup> and Ruzicka<sup>14</sup> working in Zürich in conjunction with the Society for Chemical Industry in Basel, each arrived at the goal independently. Ruzicka by synthesis isolated a new hormone which was more potent when measured by the seminal vesicle test, though weaker than androsterone when tested by the capon comb method. This, in fact, was the first substance of known chemical structure to

## TESTICULAR HORMONES.



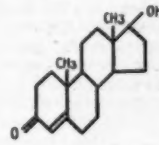
(1) Androsterone.

In male urine. Comb growth +; accessory reproductive organs of mammals: slight action.



(2) Dihydro-Androsterone.

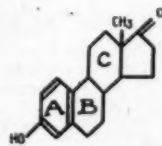
Synthetic; more active than (1).



(3) Testosterone.

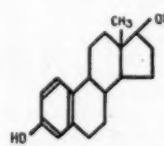
In testis; comb growth 10 x (1); accessory reproductive organs of mammals: very active.

## OESTRIN GROUP.



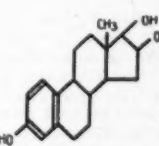
(4) Oestrone (Keto-hydroxy-Oestrin).

In urine of pregnancy.



(5) Dihydro-Oestrone.

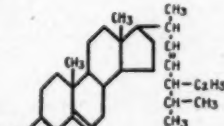
In ovary. Activity 6 x (4).



(6) Oestriol.

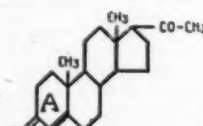
In urine of pregnancy; weaker than (4).

## CORPUS LUTEUM HORMONES.



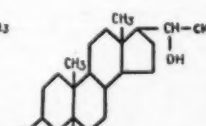
(7) Stigmasterol.

Found in plants (grass, soya bean).



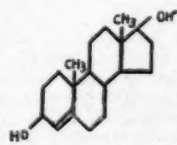
(8) Progesterone.

In corpus luteum. Synthesized from (7).

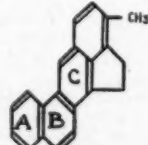


(9) Pregnandiol.

Inactive. In urine of pregnancy.



(10)



(11)

Schema showing relationship of sex hormones to each other and to carcinogenic substances.

## CARCINOGENIC SUBSTANCE.

Methyl-Cholanthrene.

Most potent agent known.

approach in its physiological properties the testicular extract hormone, the final preparation of which resulted late in 1935 with the production of androstene-3, 17-diol. [Formula (10)], which, by careful oxidation, gave a substance identical with the "testosterone" almost simultaneously isolated in the pure state from testicular extract by Laqueur.

This isolation from male urine and from male gonads of chemically unsaturated compounds acting as sex hormones enables us, now that the mechanism of chemical synthesis is understood, to formulate a reasonable

out satisfactorily. Massage every four hours for a quarter of an hour might restore circulation if the radial pulse became again palpable. The colour of the fingers was a good guide to the state of the circulation. Even if the arm was left in flexion, effleurage was often sufficient to make the radial pulse reappear.

Dr. J. C. STOREY thanked and congratulated the speakers. He wished to have the privilege of seeing Dr. Buchanan's splints in working order. He was glad that the importance of the patient's being able to bend the elbow had been stressed. Dr. Storey said that the titles of the papers had led him to believe that injuries of the elbow generally, and not only fractures, were to be dealt with. He mentioned a soldier whose joint had been flailed by surgery or by gunshot. A nail was put in and suppuration occurred. This man had a perfect false joint with almost full function, but the arm was very short. Fourteen years later the joint suppurated again. This showed how long sepsis could remain latent.

Dr. Storey spoke of another man with a broken upper radius. In this instance the man himself suggested a bandage (that he had had made by Red Cross nurses) which proved most successful.

Dr. Storey said that he would have liked to hear more about suppuration generally. It was difficult to know how much sepsis had gone into a joint. He referred to a case in which the external epicondyle had been chopped off the humerus and the elbow joint had been opened with the ax; in spite of this severe injury a joint with full movement had resulted.

Dr. Storey had been pleased to hear active movement advocated. It should be used as early as possible. There was nothing better in improving the function of the limb than its ordinary use in everyday life.

One aspect of this subject had not been mentioned, namely, the importance of insisting on a hopeful outlook, however serious the patient's injury. The initial influence of the surgeon in charge could have a considerable effect on the patient's progress.

Dr. H. L. KESTEVEN said he was interested to hear from the orthopaedic surgeons their conviction that the normal usage of the limb after injury was so valuable a measure in the restoration of full function. His recent association with an industrial undertaking enabled him to say that some at least of the employers were desirous of cooperating to this end and were prepared to provide suitable work for injured workers during later convalescence. He pointed out that to some extent the *Workers' Compensation Act* was obstructive to this because it encouraged the worker to refuse suitable light work, inasmuch as he received full compensation throughout the convalescence and therefore gained no monetary advantage by accepting the light labour offered.

Dr. E. B. M. VANCE regretted that Dr. Scougall had not the opportunity to cover the ground more fully. He was particularly interested in supracondylar fractures of the elbow joint in children from six to ten years old. No matter how great was the oedema round the elbow, reduction should be brought about as soon as possible. In reduction, the last thing that he would think of using was local anaesthesia or any other device than that of complete general anaesthesia. For counter-traction Dr. Vance put a roller towel over the end of the bed and through the armpit. He made traction in extension and exaggerated the deformity to clear the upper from the lower portion; then he brought the limb into flexion and pronated the forearm. If full flexion was attained the tension could be released a little and a cuff and collar splint alone could be put on. No matter how gross the symptoms, the first question was to obtain reduction, and the first item in reduction was a little traction plus an exaggeration of the deformity before reduction was begun.

Dr. Vance was sorry that nothing had been said about the removal of the head of the radius in complete or partial fracture. He stressed the importance of very early active movements for full recovery.

Dr. Buchanan, in reply, said that the discussion had been very interesting; he could not find anything to quarrel

with. Dr. Nelson had said that his splints could be used only as bed splints. The abduction splint could be used as a bed splint; but, with an increased angle forward of the frontal plane, it was comfortable for the ambulatory patient.

He had been interested in Dr. Glissan's remarks and agreed about the importance of nerves. He also agreed with the emphasis on active exercise in other joints than those affected. Dr. Buchanan intentionally did not specify the type of injury for which his splints were intended. Only when speaking of two very difficult types of fracture had he done this.

As to the danger of local anaesthesia: in theory Dr. Buchanan agreed with its use, but in practice he had used it only occasionally, and with reluctance, for fear of subsequent infection. He would, however, like to know the experience of the meeting in this matter.

Dr. Buchanan agreed with Dr. Vance that reduction should be carried out early. It was an urgent operation in which every hour counted.

Dr. Scougall, in reply said that he was indebted to Dr. Kesteven for coming to the meeting and for telling them about the Queensland lung fish. In Australia there were fauna that were unique because of the light that they threw on the evolution of the elbow joint.

Dr. Nelson had said that Dr. Scougall omitted to mention skeletal traction in speaking of supracondylar fractures. Up to the present Dr. Scougall had not found it necessary to use skeletal traction in the cases that had come his way. But since Kirschner wire traction was used in some fractures of the elbow joint, he conceded that it would be correct to use it in supracondylar fractures if no other method was possible.

In Dr. Scougall's series there had been no open operations and he was surprised to find that the number was so large at the Royal Alexandra Hospital for Children. Perhaps there more gross fractures were seen than at the Royal North Shore Hospital.

In reply to Dr. Glissan's remarks about the over-complexity of these papers for general practitioners, Dr. Scougall said that he had hoped to cope with that aspect by giving a summary at the end of his paper. Dr. Scougall was interested in Dr. Glissan's story about the radial pulse. In the child that he had mentioned with ischemia, blood had been lost so that a transfusion had been necessary. He had been alarmed because on the following day there was no radial pulse in the arm; but he had found that the artery had been accidentally tied while the transfusion was being given.

Dr. Scougall agreed with Dr. Glissan about the greenstick type of supracondylar fracture. The point concerning fractures was to determine which were the displacements that mattered and which were those that did not. All displacements should be considered with regard to mechanical effect on the neighbouring joints.

In reply to Dr. Callow, Dr. Scougall said that he had never used local anaesthesia himself.

Dr. Vance's principle of attaining over-correction of deformity first would no doubt be of value in his capable hands. But for the general practitioner, seeing only a few such cases, Dr. Scougall doubted the wisdom of this procedure.

Dr. Scougall agreed with what had been said concerning the results of removal of the head of the radius. The criteria for this operation in the adult were that if there was little or no displacement it should be left alone; if a small piece up to one-third was displaced it should be removed; if there was greater involvement, then the whole head of the radius should be removed.

#### NOMINATIONS AND ELECTIONS.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

Scott, John Linsley Dalkeith, M.B., B.S., 1936 (Univ. Sydney), Sydney Hospital, Sydney.

Reid, David Robertson, M.B., B.S., 1935 (Univ. Sydney), Eastern Suburbs Hospital, Waverley.

The undermentioned have been elected members of the Victorian Branch of the British Medical Association:

Cade, John Frederick Joseph, M.B., B.S., 1934 (Univ. Melbourne), Mental Hospital, Royal Park.

Heyward, William Beaumont, M.B., 1897, Ch.B., 1898, M.D., 1905 (Univ. Melbourne), 6 Currajong Road, Auburn, E.3.

Jolly, Alexander Thomas Hicks, M.B., B.S., 1935 (Univ. Melbourne), Alfred Hospital, Prahran, S.1.

The undermentioned have been elected members of the South Australian Branch of the British Medical Association:

West, Leonard Roy, M.B., B.S., 1934 (Univ. Adelaide).  
Bowering, Beryl, M.B., B.S., 1933 (Univ. Adelaide).

## Correspondence.

### OXYURIASIS: A POSSIBLE MAIN SOURCE OF INFESTATION.

SIR: It would be interesting to make quite sure that no sort of misunderstanding occurred regarding the identification of the worms from rabbits referred to in the letter from Dr. Humphreys in the journal of November 21 last. Human threadworms (*Enterobius vermicularis*) have not been previously reported from rabbits. The genus *Enterobius* is found in primates; the species *Enterobius vermicularis* has been reported from primates other than man and also from dogs, although doubt is cast upon the correctness of these latter identifications. *Passalurus ambiguus*, very like the human threadworm, is often found in the large caecum of rabbits.

In Australia there seems to exist a popular belief that human worms are commonly acquired from rabbits. Actually there are no species found in both man and the rabbit except as rarities. Hydatids in rabbits in particular occur very exceptionally, if at all, but are popularly supposed to be important sources of infection of man (through dogs), owing to the very common presence of bladder worms of other species of tapeworms in rabbits.

As to a different point touched on by Dr. Humphreys, the well-known difficulty in eradicating human threadworms, it has often been suggested that these worms, unlike most parasitic worms, may be able to multiply within the body. Complete proof has not been provided, and the view has not been generally accepted. Such a life cycle might explain such facts as the recurrence of heavy infestation after treatment which has removed many of the worms and while measures to minimize reinfestation by the mouth are being carried out, and the very heavy infestations sometimes seen in persons who seem unlikely to be accidentally ingesting eggs in such numbers. Some observations I made on the related worm *Passalurus ambiguus*, while investigating parasites of rabbits some years ago, seemed to me to support the theory very strongly, and since 1929 its possible truth has been emphasized in the lectures on worms at the School of Public Health and Tropical Medicine. I noticed, for instance, enormous numbers of these worms, including great numbers of larvæ, in several rabbits at the Commonwealth Serum Laboratories, Melbourne, which were living under conditions in which the ingestion of more than a small number of eggs seemed highly improbable. They were isolated in very clean cages, the number of eggs present either in the faeces or on the skin near the anus was small, and although mature females still containing eggs escaped from time to time with the faecal pellets,

ingestion of these at a rate sufficient to account for the numbers of larvæ in the caecum seemed very unlikely. The view that *Passalurus ambiguus* of rabbits and the threadworms of man multiply within the body has been put forward in papers containing interesting observations by Penso in recent years (*Annales de parasitologie humaine et comparée*, Volume X, 1932, page 271, and Volume XI, 1933, page 263).

As I believe that the hypothesis will be confirmed, and as it is of clinical interest if true, this opportunity is taken to call attention to it here. It is not intended, of course, to contest the facts that eggs are deposited near the anus by the gravid female worms and that transmission to another or the same host takes place by ingestion of such eggs; what is suggested is that in addition eggs are laid either continuously or periodically within the body and give rise to adult worms in the gut; the factors which regulate the phases of this more complex life history are unknown.

At any rate it is a curious fact that the life history of the common threadworm of man, recorded from very early times and found in all races and climes, should still be in dispute.

Yours, etc.,

G. A. M. HEYDON.

School of Public Health and Tropical Medicine,  
University of Sydney,  
December 7, 1936.

## University Intelligence.

### THE UNIVERSITY OF SYDNEY.

A MEETING of the Senate of the University of Sydney was held on Monday, December 7, 1936.

The Honourable Mr. Justice Halse Rogers, B.A., B.C.L., was unanimously elected as Chancellor succeeding Sir Mungo MacCallum, who recently retired from that office.

The new Chancellor graduated Bachelor of Arts in 1905 with Honours in Latin, Greek and History. He was elected Rhodes Scholar during the same year. At Oxford he gained the degree of B.C.L. as a student of Worcester College. He was first elected to the Senate in 1929 and became Deputy Chancellor in 1934. He is, at present, abroad, and will return to Sydney in February of next year.

The following degrees were conferred: *Doctor of Medicine (M.D.)*, Philip Neville Walker-Taylor; *Master of Surgery (M.S.)*, Norman Richard Wyndham.

The Diploma in Psychiatry was awarded to Alfred Broughton Barry, M.B., Ch.M.

The Senate was informed by the Vice-Chancellor that the Trustees of the Carnegie Corporation of New York had appropriated the sum of 25,000 dollars (£6,361) for the support of research in the University. A programme of research work to be carried out within the next two years has been drawn up and approved by the Trustees.

Appointments: Dame Constance D'Arcy as a representative of the University on the Provisional Council of the newly established Institute of Almoners; Mr. A. Carrodus, M.B., B.S., as the Gordon Craig Fellow in Urology.

The Faculty of Science reported that it has elected Professor W. J. Dakin as Fellow of the Senate and Dean of the Faculty of Science as from December 15.

## Books Received.

ABSORPTION FROM THE INTESTINE, by Professor F. Vezár, assisted by E. J. McDougall, Ph.D.; 1936. London: Longmans, Green and Company. Medium 8vo, pp. 305, with 70 illustrations, many of which are in colour. Price: 21s. net.



**STATISTICAL METHODS FOR RESEARCH WORKERS**, by R. A. Fisher, Sc.D., F.R.S.; Sixth Edition, revised and enlarged; 1936. Edinburgh: Oliver and Boyd. Medium 8vo, pp. 351. Price: 15s. net.

**BAINBRIDGE AND MENZIES' ESSENTIALS OF PHYSIOLOGY**, edited and revised by H. Bainbridge, M.A., M.D., Sc.D., M.R.C.P., F.R.S.; Eighth Edition; 1936. London: Longmans, Green and Company. Medium 8vo, pp. 696, with illustrations. Price: 14s. net.

**ILLUSTRATIONS OF REGIONAL ANATOMY**, by E. B. Jamieson, M.D.; Section VI: Upper Limb (containing 42 plates); Section VII: Lower Limb (containing 52 plates); 1936. Edinburgh: E. and S. Livingstone. Double foolscap 8vo. Price: Section VI, 7s. 6d. net; Section VII, 10s. net.

**THE QUEEN CHARLOTTE'S TEXT-BOOK OF OBSTETRICS**, Fourth Edition; 1936. London: J. and A. Churchill, Limited. Medium 8vo, pp. 685, with four coloured plates and 291 text figures. Price: 18s. net.

**ELEMENTARY PATHOLOGY: AN INTRODUCTION TO THE PROCESS OF DISEASE**, by K. S. Thompson; 1936. London: H. K. Lewis and Company Limited. Crown 4to, pp. 88, with illustrations. Price: 10s. 6d. net.

**ARTHRITIS IN WOMEN (A CLINICAL SURVEY)**, by R. F. Fox, M.D., F.R.C.P., F.R.Met.Soc.; 1936. London: H. K. Lewis and Company Limited. Royal 8vo, pp. 36. Price: 2s. 6d. net.

**AN INTRODUCTION TO DERMATOLOGY, WITH A CHAPTER ON THE THEORY AND TECHNIQUE OF X-RAY AND RADIUM THERAPY**, by E. H. Molesworth, M.D., Ch.M., with foreword by J. Jadassohn; 1936. London: J. and A. Churchill Limited. Demy 8vo, pp. 536, with illustrations. Price: 25s. net.

**PRINCIPLES OF BIOCHEMISTRY**, by A. P. Mathews; 1936. London: Baillière, Tindall and Cox. Royal 8vo, pp. 522. Price: 20s. net.

**CONTRACEPTION AS A THERAPEUTIC MEASURE**, by R. L. Moses, M.D.; 1936. London: Baillière, Tindall and Cox. Crown 8vo, pp. 119. Price: 4s. 6d. net.

**PHYSIOLOGICAL PRINCIPLES IN TREATMENT**, by W. Langdon-Brown, M.A., M.D., F.R.C.P., and R. Hilton, M.A., M.D., F.R.C.P.; Seventh Edition; 1936. London: Baillière, Tindall and Cox. Royal 8vo, pp. 319. Price: 10s. 6d. net.

**TISSUE IMMUNITY**, by R. L. Kahn, M.S., D.Sc.; 1936. London: Baillière, Tindall and Cox. Royal 8vo, pp. 727, with illustrations. Price: 34s. net.

**THE MANAGEMENT OF THE NEW-BORN BABY: A GUIDE FOR MIDWIVES**, by A. Moncrieff, M.D., F.R.C.P.; 1936. London: Association of Maternity and Child Welfare Centres. Crown 8vo, pp. 48. Price: 9d. net.

**A HANDBOOK ON DISEASES OF CHILDREN, INCLUDING DIETETICS, WELFARE AND THE COMMON FEVERS**, by B. Williamson, M.D., M.R.C.P.; Second Edition; 1936. Edinburgh: E. and S. Livingstone. Crown 8vo, pp. 340, with illustrations. Price: 10s. 6d. net.

**A SYSTEM OF CLINICAL MEDICINE, DEALING WITH THE DIAGNOSIS, PROGNOSIS AND TREATMENT OF DISEASE FOR STUDENTS AND PRACTITIONERS**, by T. D. Savill, M.D., edited by A. Savill, M.D., and E. C. Warner, M.D., F.R.C.P.; Tenth Edition; 1936. London: Edward Arnold and Company. Royal 8vo, pp. 1142, with illustrations. Price: 28s. net.

## Medical Appointments Vacant, etc.

For announcements of medical appointments vacant, assistants, locum tenentes sought, etc., see "Advertiser", pages xvi-xix.

**ADELAIDE CHILDREN'S HOSPITAL, ADELAIDE, SOUTH AUSTRALIA:** Resident Medical Officers.

**BALMAIN AND DISTRICT HOSPITAL, BALMAIN, NEW SOUTH WALES:** Junior Resident Medical Officer.

**FREMANTLE HOSPITAL, FREMANTLE, WESTERN AUSTRALIA:** Resident Junior Medical Officer.

**LORD HOWE ISLAND BOARD OF CONTROL:** Medical Officers.

**PUBLIC SERVICE BOARD, ADELAIDE, SOUTH AUSTRALIA:** Medical Superintendent.

**THE EASTERN SUBURBS HOSPITAL, WAVERLEY, NEW SOUTH WALES:** Honorary Dermatologist.

**THE OTAGO HOSPITAL BOARD, DUNEDIN, NEW ZEALAND:** Radio-Therapist.

**THE RACHEL FORSTER HOSPITAL FOR WOMEN AND CHILDREN, SYDNEY, NEW SOUTH WALES:** Resident Medical Officers, Medical Registrar.

## Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment referred to in the following table without having first communicated with the Honorary Secretary of the Branch named in the first column, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

BRANCHES.	APPOINTMENTS.
	Australian Natives' Association. Ashfield and District United Friendly Societies' Dispensary. Balmuir United Friendly Societies' Dispensary.
NEW SOUTH WALES: Honorary Secretary, 135, Macquarie Street, Sydney.	Friendly Society Lodges at Casino. Leichhardt and Petersham United Friendly Societies' Dispensary. Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney. North Sydney Friendly Societies' Dispensary Limited. People's Prudential Assurance Company Limited. Phoenix Mutual Provident Society.
VICTORIAN: Honorary Secretary, Medical Society Hall, East Melbourne.	All Institutes or Medical Dispensaries. Australian Prudential Association, Proprietary, Limited. Mutual National Provident Club. National Provident Association. Hospital or other appointments outside Victoria.
QUEENSLAND: Honorary Secretary, B.M.A. Building, Adelaide Street, Brisbane.	Brisbane Associate Friendly Societies' Medical Institute. Prosperpine District Hospital. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY Hospital are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.
SOUTH AUSTRALIAN: Secretary, 178, North Terrace, Adelaide.	All Lodge appointments in South Australia. All Contract Practice Appointments in South Australia.
WESTERN AUSTRALIAN: Honorary Secretary, 205, Saint George's Terrace, Perth.	All Contract Practice Appointments in Western Australia.

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